References

- A. P. Kaur, A. Helwig and N. Das, "SFRA transformer reliability engineering modelling for undergraduates," in 2016 Australasian Universities Power Engineering Conference (AUPEC), Brisbane, 2016.
- [2] Cigre Working Group A2.37, Transformer Reliability Survey, Electra, no. 261, p. 48-49.
- [3] A. Kraetge, M. Krüger, J. L. Velásquez, M. Heindl, and S. Tenbohlen, "Experiences with practical application of Sweep Frequency Response Analysis (SFRA) on power transformers," in *Proc. of the 16th International Symposium on High Voltage Engineering* © 2009 SAIEE, Johannesburg, 2009.
- [4] *IEEE Guide for the Application and Interpretation of Frequency Response Analysis for Oil-Immersed Transformers, IEEE Std C57.149, 2012.*
- [5] F. Predl, "Interpretation of Sweep Frequency Response Analysis (SFRA) Measurement Results," in *Techcon Asia-Pacific 2016*, Sydney, 2016.
- [6] D. K. Xu, C. Z. Fu and Y. M. Li, "Application of artificial neural network to the detection of the transformer winding deformation," in 1999 Eleventh International Symposium on High Voltage Engineering, London, 1999.
- [7] A. Contin, G. Rabach, J. Borghetto, M. D. Nigris, R. Passaglia and G. Rizzi,
 "Frequency-response analysis of power transformers by means of fuzzy tools," *IEEE Transactions on Dielectrics and Electrical Insulation*, vol. 18, no. 3, pp. 900-909, June 2011.
- [8] P. M. Joshi and S. V. Kulkarni, "Transformer winding diagnostics using deformation coefficient," in 2008 IEEE Power and Energy Society General Meeting - Conversion and Delivery of Electrical Energy in the 21st Century, Pittsburgh, 2008.
- [9] J. C. Gonzales and E. E. Mombello, "Automatic detection of frequency ranges of power transformer transfer functions for evaluation by mathematical indicators," in 2012 Sixth IEEE/PES Transmission and Distribution: Latin

America Conference and Exposition (T&D-LA), Montevideo, 2012.

- [10] P. Vaessen, "Transformer model for high frequencies," *IEEE Trans. Power Del.*, vol. 3, no. 4, p. 1761–1768, Oct. 1988.
- [11] A. Morched, L. Marti, and J. Ottewangers, "A high frequency transformer model for the EMTP," *IEEE Trans. Power Del.*, vol. 8, no. 3, p. 1615–1626, Jul. 1993.
- [12] K. Ragavan and L. Satish, "Construction of Physically Realizable Driving-Point Function From Measured Frequency Response Data on a Model Winding," *IEEE Transactions on Power Delivery*, vol. 23, no. 2, pp. 760-767, April 2008.
- [13] V. Rashtchi, E. Rahimpour and E.M. Rezapour, "Using a genetic algorithm for parameter identification of transformer R-L-C-M model," *Electrical Engineering*, vol. 88, no. 5, pp. 417-422, 2006.
- [14] G. B. Gharehpetian, H. Mohseni, and K. Moller, "Hybrid modeling of inhomogeneous transformer windings for very fast transient overvoltage studies," *IEEE Transactions on Power Delivery*, vol. 13, no. 1, p. 157–163, Jan. 1998.
- [15] Measurement of frequency response, IEC 60076-18, 2012.
- [16] V Behjat, A Vahedi, A Setayeshmehr, H Borsi and E Gockenbach, "Identification of the most sensitive frequency response measurement technique for diagnosis of interturn faults in power transformers," *Meas. Sci. Technol. 21*, vol. 21:1–14, 2010.
- [17] S. Tenbohlen and S. A. Ryder, "Making frequency response analysis measurements: a comparison of the swept frequency and low voltage impulse methods," in *Xlllth International Symposium on High Voltage Engineering*, Netherlands, 2003.
- [18] J. C. Gonzales and E. E. Mombello, "Fault Interpretation Algorithm Using Frequency-Response Analysis of Power Transformers," *IEEE Transactions on Power Delivery*, vol. 31, no. 3, pp. 1034-1042, June 2016.
- [19] A. A. ElFaraskoury, "Experiences of Sweep Frequency Response Analyser for

the Diagnosis of Transformer Winding Damage," in 17th International Middle-East Power System Conference (MEPCON'15) Mansoura University, Egypt, 2015.

- [20] R. D. Jiwane, "Detection Of Mechanical Faults On Transformer Winding," in International conference on computing, communication and energy systems, India, 2016.
- [21] E. Dick and C. Erven, "Transformer Diagnostic Testing by Frequuency Response Analysis," *IEEE Transactions on Power Apparatus and Systems*, Vols. PAS-97, no. 6, pp. 2144-2153, 1978.
- [22] K. P. Badgujar, M. Maoyafikuddin and S. V. Kulkarni, "Alternative statistical techniques for aiding SFRA diagnostics in transformers," *IET Generation, Transmission & Distribution*, vol. 6, no. 3, pp. 189-198, March 2012.
- [23] Y. Shibuya, S. Fujita and N. Hosokawa, "Analysis of very fast transient overvoltage in transformer winding," *IEE Proceedings - Generation*, *Transmission and Distribution*, vol. 144, no. 5, pp. 461-468, Sept. 1997.
- [24] K. Ragavan and L. Satish, "Localization of Changes in a Model Winding Based on Terminal Measurements: Experimental Study," *IEEE Transactions on Power Delivery*, vol. 22, no. 3, pp. 1557-1565, July 2007.
- [25] G. Joginadham, H. A. Mangalvedekar and A. Venkatasami, "Development of networks for SFRA data using circuit synthesis," in 2008 International Conference on Condition Monitoring and Diagnosis, Beijing, 2008.
- [26] D. M. Sofian, Z. D. Wang and P. Jarman, "Interpretation of transformer FRA measurement results using winding equivalent circuit modelling technique," in *CEIDP '05. 2005 Annual Report Conference on Electrical Insulation and Dielectric Phenomena*, Nashville, TN, USA, 2005.
- [27] S. P. Ang, J. Li, Z. Wang and P. Jarman, "FRA low frequency characteristic study using duality transformer core modeling," in 2008 International Conference on Condition Monitoring and Diagnosis, Beijing, 2008.
- [28] M.R. Barzegaran, M. Mirzaie, A. S. Akmal, "Frequency Response Analysis in Power Transformer for Detection of Winding Short-circuit using Quasi-static

Finite Element and Circuit-based Method," *World Applied Sciences Journal*, vol. 7, no. 8, pp. 1006-1015, 2009.

- [29] P. Mukherjee and L. Satish, "Construction of Equivalent Circuit of a Single and Isolated Transformer Winding From FRA Data Using the ABC Algorithm," *IEEE Transactions on Power Delivery*, vol. 27, no. 2, pp. 963-970, April 2012.
- [30] M. Bigdeli, D. Azizian, H Bakhshi and E. Rahimpour, "Identification of Transient Model Parameters of Transformer Using Genetic Algorithm," in 2010 International Conference on Power System Technology, Hangzhou, China, 2010.
- [31] M. S. Chaouche, H. Houassine, S. Moulahoum and I. Colak, "BA to construction of equivalent circuit of a transformer winding from frequency response analysis measurement," *IET Electric Power Applications*, vol. 12, no. 5, pp. 728-736, 2018.
- [32] A. Shintemirov, W.J. Tang, W.H. Tang and Q.H. Wu, "Improved modelling of power transformer winding using bacterial swarming algorithm and frequency response analysis," *Electric Power Systems Research*, vol. 80, no. 9, pp. 1111-1120, 2010.
- [33] M. A. Eldery, E. F. El-Saadany and M. M. A. Salama, "Parameters Identification of Sectional Winding High Frequency Trransformer Model Using Neural Network," in 2003 46th Midwest Symposium on Circuits and Systems, Cairo, 2003.
- [34] G. M. V. Zambrano, A. C. Ferreira and L. P. Caloba, "Power transformer equivalent circuit identification by artificial neural network using frequency response analysis," in 2006 IEEE Power Engineering Society General Meeting, Montreal, Que., 2006.
- [35] D. L. Alvarez, J. A. Rosero and E. E. Mombello, "Circuit model of transformers windings using vector fitting, for frequency response analysis (FRA)," in 2013 Workshop on Power Electronics and Power Quality Applications (PEPQA), , Bogota, 2013.
- [36] K. F. Man, K. S. Tang and S. Kwong,, "Genetic Algorithms: Concepts and

Applications," *IEEE Transactions on Industrial Electronics*, vol. 43, no. 5, pp. 519-534, Oct. 1996.

- [37] "MATLAB User's Guide," The Mathworks, 2018.
- [38] E. C. Levy, "Complex-curve fitting," *IRE Transactions on Automatic Control*, Vols. AC-4, no. 1, pp. 37-43, May 1959.
- [39] A. O. Soysal and A. Semlyen, "Practical transfer function estimation and its application to wide frequency range representation of transformers," *IEEE Transactions on Power Delivery*, vol. 8, no. 3, pp. 1627-1637, July 1993.
- [40] C. Sanathanan and J. Koerner, "Transfer function synthesis as a ratio of two complex polynomials," *IEEE Transactions on Automatic Control*, vol. 8, no. 1, pp. 56-58, January, 1963.
- [41] P. Payne, "An improved technique for transfer function synthesis from frequency response data," *IEEE Transactions on Automatic Control*, vol. 154, no. 4, pp. 480-483, Aug 1970.
- [42] A. K. Kamath et al., "Modeling of transformer characteristics using fractional order transfer functions," in 2009 IEEE International Conference on Control and Automation, Christchurch, 2009.
- [43] K. L. I. M. Pramod B. Jayarathna, W. E. P. Sampath Ediriweera, J. R. Lucas and R. Samarasinghe, "Modelling Transfer Function of Power Transformers Using Sweep Frequency Response Analysis," in 2018 Moratuwa Engineering Research Conference (MERCon), Moratuwa, 2018.
- [44] D. Valrio and J. S Da Costa, "Levy's identification method extended to commensurate fractional order transfer functions," in *Fifth EUROMECHNonlinear Dynamics conference*, Eindhoven, 2005.
- [45] U.A.Bakshi and S.C.Goyal, Principles of Control Systems, India: Technical Publications, 2008.
- [46] E. Bjerkan, "High frequency modeling of power transformers: Stresses and Diagnostics", Ph.D. Dissertation, Norwegian university of science and technology, May 2005.
- [47] K. R. Gandhi and K. P. Badgujar, "Artificial neural network based

identification of deviation in frequency response of power transformer windings," in 2014 Annual International Conference on Emerging Research Areas: Magnetics, Machines and Drives (AICERA/iCMMD), Kottayam, 2014.

- [48] "MATLAB ANN toolbox," MATLAB®, Mathwork Ltd., [Online]. Available: https://www.mathworks.com/discovery/neural-network.html.
- [49] "Genetic Algorithm," MATLAB®, Mathwork Ltd.. [Online].
- [50] S. Bagheri , R. Efftnejad and A. Salami , "Transformer Winding Parameter Identification based on Frequency Response Analysis using Hybrid Wavelet Transform (WT) and Simulated Annealing Algorithm (SA) and Compare with Genetic Algorithm (GA)," *Indian Journal of Science and Technology*, vol. 7, no. 5, pp. 614-621, May, 2014.
- [51] U. Sharma, S. Chatterjee and K. Bhuyan, "Development of reference SFRA plot of transformer at design stage using high frequency modelling," in 2012 *1st International Conference on Power and Energy in NERIST (ICPEN)*, Nirjuli, 2012.
- [52] "MATLAB GA Toolbox," MATLAB®, Mathwork Ltd., [Online]. Available: https://www.mathworks.com/help/gads/genetic-algorithm.html.
- [53] V. Behjat, A. Vahedi, A.Setayeshmehr, H. Borsi and Ernst Gockenbach, "Sweep frequency response analysis for diagnosis of low level short circuit faults on the windings of power transformers: An experimental study," *International Journal of Electrical Power & Energy Systems*, vol. 42, no. 1, pp. 78-90, November 2012.
- [54] S. Alsuhaibani, Y. Khan, Beroual, M. Abderrahmane and N. Hussain, "A review of frequency response analysis methods for power transformer diagnostics," *Energies*, vol. 9, no. 11, pp. 1-17, Nov 2016.
- [55] J. C. Olivares-Galvan, R. Escarela-Perez, E. Campero-Littlewood, F. de Leon and C. A. Cruz, "Separation of core losses in distribution transformers using experimental methods," *Canadian Journal of Electrical and Computer Engineering*, vol. 35, no. 1, pp. 33-39, Winter 2010.
- [56] M. F. Bin Mohd Yousof, "Frequency Response Analysis for Transformer

Winding Condition Monitoring", Ph.D. Dissertation, School of Information Technology and Electrical Engineering, University of Queensland, 2015.

- [57] T.Mariprasath and V. Kirubakaran, "Power Transformer Faults Identification using SFRA," *International Journal of Scientific & Engineering Research*, vol. 5, no. 5, pp. 581-587, May, 2014.
- [58] R. S. Bhide, M. S. S. Srinivas and I. Voloh, "Detection of inter-turn fault in transformers at incipient level," in 2014 International Conference on Electrical Machines (ICEM), Berlin, 2014.
- [59] R. Prudhvi Raj, "Transformer Core Fault Detection and Control," Advances in Electronic and Electric Engineering, vol. 3, no. 4, pp. 485-490, 2013.
- [60] G. A. T. N. Aravinda, K. Bandara, G. A. Jayantha, J. R. S. S. Kumara and M. A. R. M. Fernando, "Application of SFRA techniques to discriminate short circuit faults of transformer winding," in 2017 IEEE International Conference on Industrial and Information Systems (ICIIS), Peradeniya, 2017.
- [61] G. Energy, "geindustrial," [Online]. Available: http://apps.geindustrial.com/publibrary/checkout/LAPL0084?TNR=Articles%
 7CLAPL0084%7CPDF&filename=LAPL0084.pdf. [Accessed 4 oct 2018].
- [62] M. Bagheri, M.S. Naderi, T Blackburn and T. Phung, "Case study on FRA capability in detection of mechanical defects within a 400MVA transformer," *CIGRE, Paris, France*, pp. 1-9, 2012.
- [63] M.Florkowski and J. Furgał, "Transformer winding defects identification based on a high frequency method," *Measurement Science and Technology*, vol. 18, no. 9, p. 1986–1992, july,2007.
- [64] M. Bagheri, B. Stojcevski and B. T. Phung, "Frequency response technique to recognize turn-to-turn insulation deterioration in transformer winding," in 016 IEEE International Conference on Power and Renewable Energy (ICPRE), Shanghai, 2016.
- [65] D. Allan, C. Jones and B. Sharp, "Studies of the condition of insulation in aged power transformers. 1. Insulation condition and remnant life assessments for in-service units," in 3rd International Conference on Properties and

Applications of Dielectric Materials, tokyo, 1991.

- [66] S. Rai and N.P. Gupta, "SFRA, Detect Of Winding Deformation in Power Transformer," *IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE)*, vol. 9, no. 6, pp. 53-57, dec, 2014.
- [67] C. W. G. A2.26, Mechanical Condition Assessment of Transformer Windings Using Frequency Response Analysis (FRA), paris: Brochure, 2008.