

DOI: <https://doi.org/10.15407/techned2016.01.047>

PROBLEMS USING, MODELING AND MINIMIZING ERRORS OF HIGH VOLTAGE CURRENT TRANSFORMERS

Journal	Tekhnichna elektrodynamika
Publisher	Institute of Electrodynamics National Academy of Science of Ukraine
ISSN	1607-7970 (print), 2218-1903 (online)
Issue	№ 1, 2016 (January/February)
Pages	47 – 54

Authors

M.F. Sopel, V.I. Pankiv, E.M. Tankevych, V.V. Grechko

Institute of Electrodynamics National Academy of Sciences of Ukraine,
pr. Peremohy, 56, Kyiv-57, 03680, Ukraine,
e-mail: pankiv.volodimir@gmail.com

Abstract

The results of the search and description of the main characteristics and features of new modern mathematical models of current transformers of high-voltage electrical networks was described. The main causes of saturation of magnetic core of current transformer and distortion of the secondary current, and the most advanced to date methods and ways to reduce errors of current transformers for such operating conditions was determine. The objective of this research is to informed choice of the mathematical model of current transformers, the most suitable for their computer modeling in the design, setting up and evaluate the performance of devices and protection systems of electrical networks. References 31, figure 1.

Key words: current transformer, residual induction, saturation, mathematical model, error, correction.

Received: 26.08.2015

Accepted: 02.11.2015

Published: 29.01.2016

References

1. Ajaei F.B, Sanaye-Pasand M., Davarpanah M. Compensation of the current-transformer saturation effects for digital relays *IEEE Transaction on power delivery*. 2011. Vol. 26. No 4. P. 2531-2540. DOI: <https://doi.org/10.1109/TPWRD.2011.2161622>
2. Al-Abbas N.H. Efficient proposed solutions for current transformers saturation effects on overcurrent relays operations in distribution systems. Proceedings of 44th International Universities *power engineering conference* (UPEC), 1-4 Sept., 2009, Glasgow. 2009. P. 1-6.
3. Annakkage U.D., McLaren P.G., Jayasinghe R.P., Parker A.D. A current transformer model based on the Jiles-Atherton theory of ferromagnetic hysteresis. *IEEE Transaction on power delivery*. 2000. Vol. 15. No 1. P. 57-61. DOI: <https://doi.org/10.1109/61.847229>
4. Benabou A., Clene S., Piriou F. Comparison of Preisach and Jiles-Atherton models to take into account hysteresis phenomenon for finite element analysis. *Journal of magnetism and magnetic materials*. 2003. Vol. 261. No 1-2. P. 139-160. DOI: [https://doi.org/10.1016/S0304-8853\(02\)01463-4](https://doi.org/10.1016/S0304-8853(02)01463-4)
5. Bruce R.G., Wright A. Remanent flux in current-transformer cores. *IET Proceedings of the Institution of electrical engineers*

- . 1966. Vol. 113. No 5. P. 915-920.
6. Chan J.H., Vladimirescu A., Gao X.-C. Nonlinear transformer model for circuit simulation. *IEEE Transactions on computer-aided design*
- . 1991. Vol. 10. No 4. P. 476-482.
7. Conner E.E., Greb R.G., Wentz E.C. Control of residual flux in current transformers. *IEEE Transaction on power apparatus and systems*
- . 1973. Vol. PAS-92. No 4. P. 1266-1233. DOI:
<https://doi.org/10.1109/TPAS.1973.293804>
8. Damnjanovic A., Islam A., Domijan A. Harmonic domain modeling of transformer nonlinear characteristic with piece-wise approximation. 14th International conference on *harmonics and quality of power* (ICHQP), 26-29 Sept., 2010, Bergamo. 2010. P. 1-6.
9. Guerra F., Das C.F., Mota W.S. Current transformer model. *IEEE Transaction on power delivery* . 2007. Vol. 22. No 1. P. 187-194. DOI: <https://doi.org/10.1109/TPWRD.2006.887092>
10. Henze O., Rucker W.M. Identification procedures of Preisach model. *IEEE Transactions on magnetics* . 2002. Vol. 38. No 2. P. 833-836. DOI: <https://doi.org/10.1109/20.996215>
11. Hong Y.-Y., Wei D.-W. Compensation of distorted secondary current caused by saturation and remanence in a current transformer. *IEEE Transaction on power delivery*. 2010. Vol. 25. No 1. P. 47-54. DOI: <https://doi.org/10.1109/TPWRD.2009.2034820>
12. IEEE Guide for the application of current transformers used for protective relaying purposes: IEEE C37.110-1996. N-Y.: The Institute of Electrical and Electronics Engineers, 1996. 59 p.
13. Kang Y.C., Kang S.H., Park J.K. Development and hardware implementation of a compensating algorithm for the secondary current of current transformers. *IEE Proceedings on electric power applications* . 1996. Vol. 143. No 1. P. 41-49. DOI: <https://doi.org/10.1049/ip-epa:19960040>
14. Khorashadi-Zaden H., Sanaye-Pasand M. Correction of saturated current transformers secondary current using ANNs. *IEEE Transaction on power delivery*. 2006. Vol. 21. No 1. P. 73-79. DOI: <https://doi.org/10.1109/TPWRD.2005.858799>
15. Kuczmann M. Dynamic Preisach hysteresis model. *Journal of advanced research in physics* . 2010. Vol. 1. No 1. P. 1-5.
16. Liu S.-T., Huang S.-R., Chen H.-W. Using TACS functions within EMTP to set up current-transformer model based on the Jiles-Atherton theory of ferromagnetic hysteresis. *IEEE Transaction on power delivery* . 2007. Vol. 22. No 4. P. 2222-2227. DOI: <https://doi.org/10.1109/TPWRD.2007.905809>
17. Locci N., Muscas C. A digital compensation method for improving current transformer accuracy. *IEEE Transaction on power delivery*. 2000. Vol. 15. No 4. P. 1104-1109. DOI: <http://doi.org/10.1109/63.887092>

[s://doi.org/10.1109/61.891489](https://doi.org/10.1109/61.891489)

18. Locci N., Muscas C. Hysteresis and eddy currents compensation in current transformer. *IE EE Transaction on power delivery*. 2001. Vol. 16. No 2. P. 154-159. DOI: <https://doi.org/10.1109/61.915475>
19. Naghizadeh R.-A., Vahidi B., Hosseini S.H. Parameter identification of Jiles-Atherton model using SFLA. *Computation and mathematics in electrical and electronic engineering*. 2012. Vol. 31. No 4. P. 1293-1309.
20. Pan J., Vu K., Hu Y. An efficient compensation algorithm for current transformer saturation effects. *IEEE Transaction on power delivery*. 2004. Vol. 19. No 4. P. 1623-1628. DOI: <https://doi.org/10.1109/TPWRD.2004.835273>
21. Rezaei-Zare A., Iravany R., Sanaye-Pasand M. An accurate current transformer model based on Preisach theory for the analysis of electromagnetic transients. *IEEE Transaction on power delivery*. 2008. Vol. 23. No 1. P. 233-242. DOI: <https://doi.org/10.1109/TPWRD.2007.905416>
22. Smith T., Hunt R. Current transformer saturation effects on coordinating interval. *IEEE Transactions on industry applications*. 2013. Vol. 49. No 2. P. 825-831. DOI: <https://doi.org/10.1109/TIA.2013.2243397>
23. Stachel P., Schegner P. Detection and correction of current transformer saturation effects in secondary current signals. *IEEE Power & energy society general meeting PES'09.*, 26-30 July 2009, Calgary. 2009. P. 1-6.
24. Stognii B.S., Selehman N.A., Tankevych Ye.N. A mathematical model of electromagnetic processes in the current transformers and determining its characteristics. *Tekhnicheskaya Elektrodynamika*. 1993. No 2. P. 58-61.
25. Stognii B.S., Selehman N.A., Tankevych Ye.N. Digital restoration of the output of high-voltage measurement current transformers. *Tekhnicheskaya Elektrodynamika*. 1993. No 5. P. 64-67.
26. The effects of EHV relaying of fault and switching generated transients. Working group 04 of study committee № 34. Protection. *La conference internationale des grands reseaux electrique*, Cigre session 30 aug. 7 sept., 1978. P. 1-15.
27. Tziouvaras D.A., McLaren P., Alexander G. Mathematical models for current, voltage and coupling capacitor voltage transformers. *IEEE Transaction on power delivery*. 2000. Vol. 15. No 1. P. 62-72. DOI: <https://doi.org/10.1109/61.847230>
28. Wiszniewski A., Rebizant W., Schiel L. Correction of current transformer transient performance. *IEEE Transaction on power delivery*. 2008. Vol. 23. No 2. P. 624-632. DOI: <https://doi.org/10.1109/TPWRD.2008.915832>
29. Yu C.-S. Detection and correction of saturated current transformer measurements using decaying DC components. *IEEE Transaction on power delivery*. 2010. Vol. 25. No 3. P. 1340-1347.

30. Yu D.C., Cummins J.C., Wang Z. Correction of current transformer distorted secondary currents due to saturation using artificial neural networks. IEEE Transaction on *power delivery*. 2001. Vol. 16. No 2. P. 189-194.
31. Zhang D., Chen J.C., Phung T. Study on transient and frequency response of current transformer using Jiles-Atherton model. 2013 IEEE TENCON Spring conference, 17-19 April, 2013, Sydney. 2013. Pp. 257-261. DOI: <https://doi.org/10.1109/61.915481>

[PDF](#)