dc

A Novel Distance Protection Immune to the Effects of CVT Transients Using Artificial Neural Network

H. Khorashadi-Zadeh Department of Power Eng., University of Birjand

Abstract

This paper presents the design of a novel method for improvement of the operation of distance relays during capacitive voltage transformer transients using artificial neural network. The proposed module uses voltage and current signals to learn the hidden relationship existing in the input patterns. Simulation studies are preformed and the influence of changing system parameters, such as fault resistance and source impedance is studied. Details of the design procedure and the results of performance studies with the proposed relay are given in the paper. Performance studies show that the neural networks improve the operation of distance relays during capacitive voltage transformer transients and reduce the effects of system variables such as fault resistance, source impedance and decaying DC offset on the decision made by the distance relay.

Key words: Distance relay, CVT transient, Artificial neural network.



Monitoring
Generalization





.

()

.



1- Phase-Selection



Superimposed

.





	-	
	1	1
	Ι	Ι
	1	1
	1	1
	1	1



SIR

SIR



.

1

DFT	
D 1 1	

			Θ	Δ	Rf=0 Ω		Rf=5Ω		Rf=10 Ω	
	(km)	SIR	(°)	(°)	(°) DFT ANN					
					DFT	ANN	DFT	ANN	DFT	ANN
AG					Tr	Tr	Tr	Tr	Tr	Tr
AG				-	Tr	Tr	Tr	Tr	Tr	Tr
ABG					Tr	Tr	Tr	Tr	Tr	Tr
ABG				-	Tr	Tr	Tr	Tr	No-Tr	Tr
CG				-	Tr	Tr	Tr	Tr	No-Tr	Tr
CG					Tr	Tr	Tr	Tr	No-Tr	Tr
BC					Tr	Tr				<u>.</u>
BC				-	Tr	Tr				
ACG					Tr	Tr	No-Tr	Tr	No-Tr	Tr
ACG				-	Tr	Tr	Tr	Tr	No-Tr	Tr
AG					Tr	Tr	No-Tr	Tr	No-Tr	Tr
AG				-	Tr	Tr	Tr	Tr	No-Tr	Tr
CG					Tr	Tr	No-Tr	Tr	No-Tr	Tr
CG				-	Tr	Tr	No-Tr	Tr	No-Tr	Tr
AC				(Tr	No-Tr				
CG					Tr	No-Tr	No-Tr	No-Tr	No-Tr	No-Tr
ABG					Tr	No-Tr	No-Tr	No-Tr	No-Tr	No-Tr
BC					Tr	No-Tr			•	
ACG					Tr	No-Tr	No-Tr	No-Tr	No-Tr	No-Tr
	P			1		<u> </u>			<u> </u>	<u> </u>

.

-

.

Gener. Transmission Distribution, 1995, 142(4), pp. 386-392.

•••

- [10] El-Gallas, A.I. El-Hawary and M. Sallam, A.A. Kalas, "Swarm-Intelligently Trained Neural Network for Power Transformer Protection," Canadian Conference on Electrical and Computer Engineering, vol. 1, 13-16 May 2001, pp. 265-269.
- [11] A.L. Orille-Fernandez, N.K.I. Ghonaim and J.A Valencia, "A FIRANN as a Differential Relay for Three Phase Power Transformer Protection," IEEE Transactions on Power Delivery, vol. 16, no. 2, Apr. 2001 pp. 215-218.
- [12] M.M. Saha, J. Izykowski, M. Lukowicz and E Rosolowski "Application of ANN Methods for Instrument Transformer Correction in Transmission Line Protection," Proc. of the 7th Int. IEE Conference Developments in Power System Protection DPSP 2001, 9-12 April 2001, pp. 303-306.
- [13] A. Sweetana, "Transient Response Characteristics of Capacitive Potential Devices," IEEE Transactions on Power Apparatus and Systems, vol. 90, no. 5, September/October, 1971.
- [14] IEEE Committee Report "Transient Response of Coupling Capacitor Voltage Transformers," IEEE Transactions on Power Apparatus and Systems, PAS-100, no. 5, May 70, pp. 42-46.
- [15] H.J. Vermeulen, "Equivalent Circuit Modeling of a Capacitive Voltage Transformer for Power System Harmonic Frequencies," IEEE Transactions on Power Delivery, vol. 10 no. 4, October 1995.
- [16] PSCAD/EMTDC User's Manual, Manitoba HVDC Research Center, Winnipeg, Manitoba, Canada.
- [17] A. Ferrero, S. Sangiovanni and E. Zappitelli, "A New Algorithm for Digital Relaying with Symmetrical Components," Proc. IMEKO TC-4 International Symposium on Intelligent Instrumentation for remote and On-Site Measurements, Brussels, 12-13 May 1993, pp. 341-345.
- [18] M.T. Hagan and M.B. Menhaj, "Training Feedforward Networks With the Marquardt Algorithm," IEEE Trans. on Neural Networks, vol. 5, no. 6, 1994, pp. 989-993.

- M. Kezunoic, C.W. Fromen and S.L. Nilsson, "Digital Models of Coupling Capacitor Voltage Transformers for Protective Relay Transient Studies," IEEE Transactions on Power Delivery, vol. 7 no. 4, October 1992.
- [2] D. Hou and J. Roberts, "Capacitive Voltage Transformer: Transient Overreach concerns and Solutions for Distance Relaying," Canadian Conference on Electrical and Computer Engineering, vol. 1, 26-29 May 1996, pp. 119–125.
- H.B. Siguerdidjane, "Application of Digital Power Simulators: advantages," Proceedings of First International Conference on Digital Power System Simulators, College Station, TX, USA, April 1995, pp. 83-87.
- [4] J. Izykwski, B. Kaztenny, E. Rosolowski, M. Saha and B. Hillstrom, "Dynamic Compensation of Capacitive Voltage Transformer," IEEE Transactions on Power Delivery, vol. 13, no. 1, January 1998.
- [5] B. Kasztenny, et al, "Distance Relays and Capacitive Voltage Transformers – Balancing Speed and Transient Overreach," 53rd Annual Conference for Protective Relay Engineers
- [6] H. Khorashadi-Zadeh, "Correction of Capacitive Voltage Transformer Distorted Secondary Voltages Using Artificial Neural Networks," In Proceedings Seventh Seminar on Neural Network Applications in Electrical Engineering, Sep. 2004, Belgrad-serbia and Montenegro (Neural 2004).
- [7] M. Kezonuic, "A Survey of Neural Net Application to Protective Relaying and Fault Analysis," Eng. Int. Sys. vol. 5, no. 4, Dec. 1997, pp. 185-192.
- [8] H. Khorashadi Zadeh and M. Sanaye-Pasand "Power Transformer Differential Protection Scheme Based on Wavelet Transform and Artificial Neural Network Algorithms," Proc. of the 39nd International Universities Power Engineering Conference, UPEC2004, 2004, pp. 747-753.
- [9] P. Bastard, M. Meunier and H. Regal, "Neural Network-Based Algorithm for Power Transformer Differntial Relays," IEE Proc.