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

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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.

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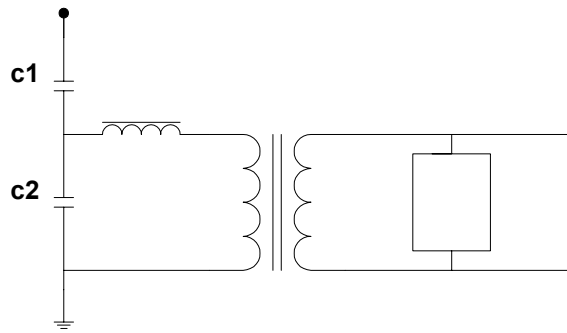
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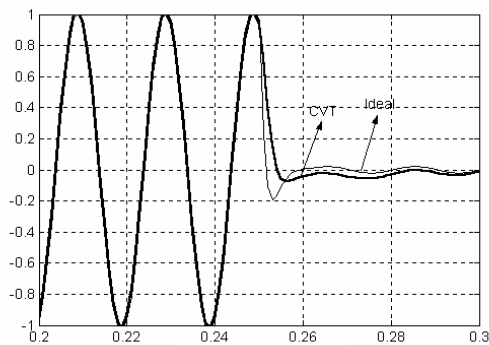
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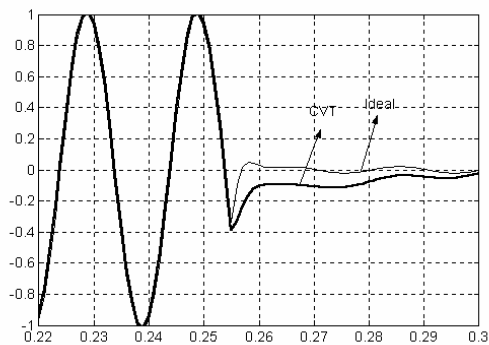
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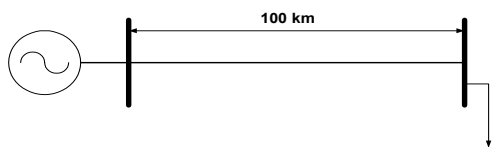
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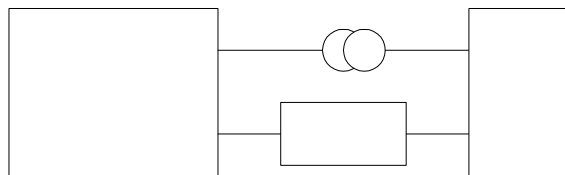
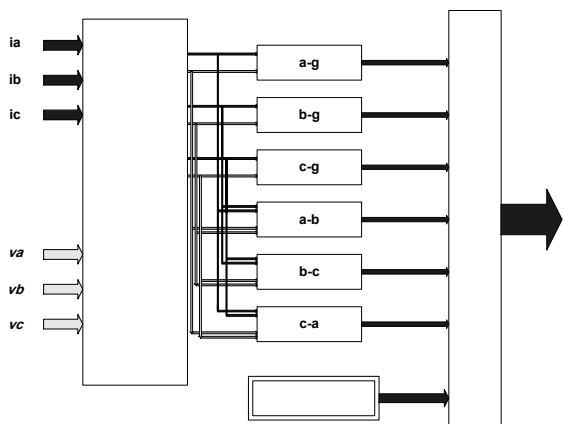
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$l + j l$	Ω/km
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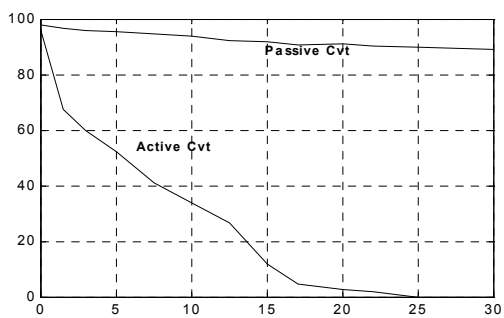
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	1.4kΩ, 1.2H
	0.125Ω, 0.125mH
	22 (kV): 0.110 (kV)
C1 (nF)	2.2
C2 (nF)	0.5
L (H) ()	253.4
(Hz)	50
(kV)	400

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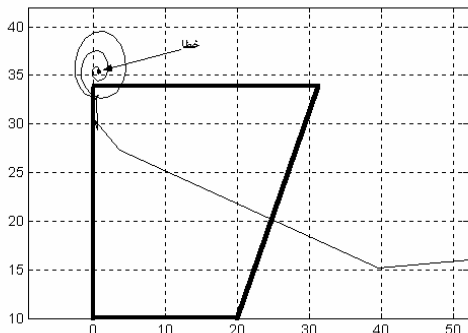


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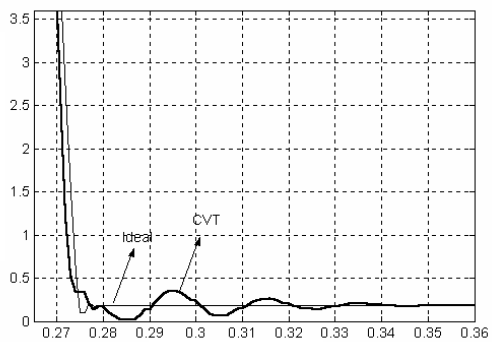
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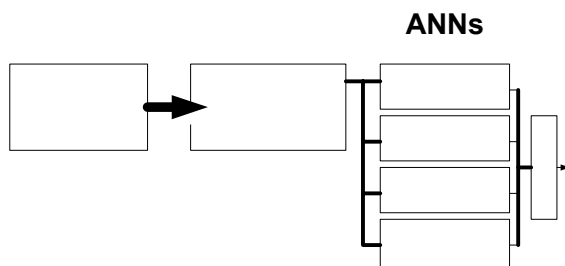
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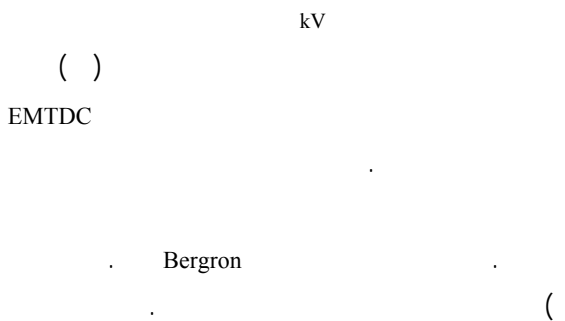
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Superimposed

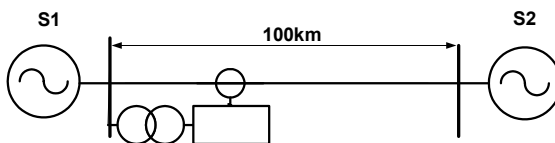
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Ω/km	$/ +j /$
Ω	$/$
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(Ω)	$/ \times -$
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(m)	$/$
(Hz)	
(kV)	

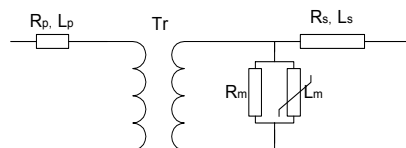


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SIR ABG

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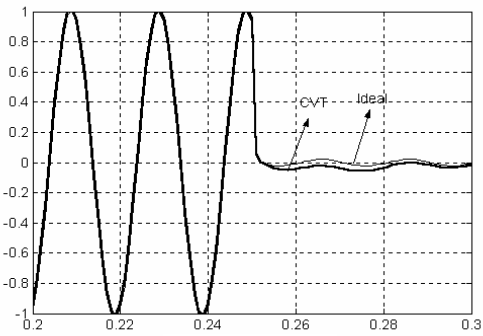
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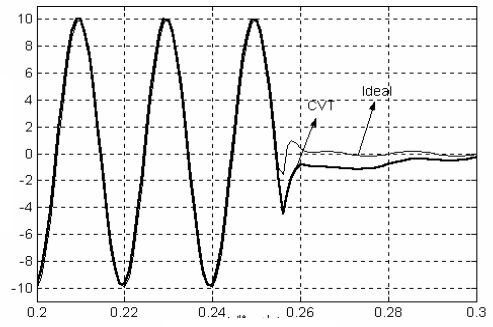
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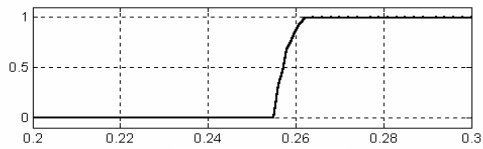
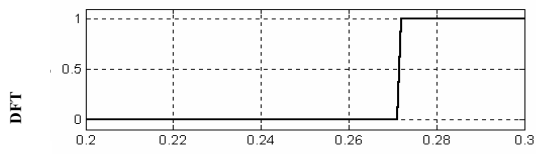
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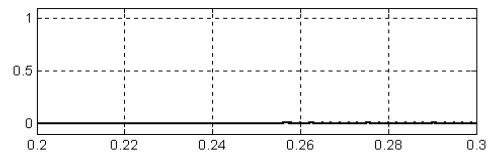
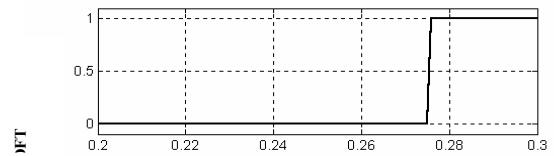


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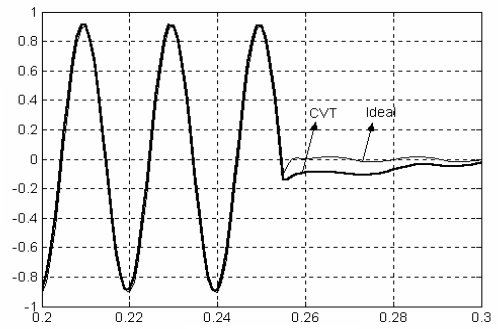
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$\theta \Delta$

SIR

DFT



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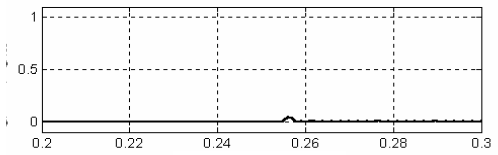
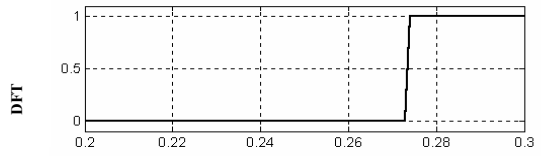
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S_2

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SIR

Rf

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	(km)	SIR	Θ (°)	Δ (°)	Rf=0 Ω		Rf=5 Ω		Rf=10 Ω	
					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				
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

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