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CERTIFICATE

I, **Nitu Dhyani**, Roll No. 2K12/PSY/14 student of M. Tech. (Power System), hereby declare that the dissertation/project titled "**Soft Computing Techniques for Controlling D-STATCOM in Distribution System**" under the supervision of Assoc. Prof. Alka Singh of Electrical Engineering Department Delhi Technological University in partial fulfillment of the requirement for the award of the degree of Master of Technology has not been submitted elsewhere for the award of any Degree.

Place: Delhi **(NITU DHYANI)**
Date: 31.07.2014

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ABSTRACT

In recent years, there has been an exponential increase in energy demand in domestic, commercial and industrial sectors. Applications of electronically controlled devices provide automatic control in modern power system; yet due to their non linear characteristics, the current or voltage waveform deviates from the ideal sinusoidal waveform. Arc furnaces, converters, variable speed AC drives etc inject harmonics into the power system and affect the working of other sensitive devices. This may lead to partial or complete rupturing of equipment and blackouts. The presence of harmonics increases the transformer temperature, leading to equipment heating and increased losses. Sudden addition or removal of large load or capacitor bank results in voltage fluctuation causing sag and swell in system voltage. These problems are collectively grouped as power quality issues and the researchers are working worldwide to find solutions to these power quality problems for improving the efficiency and reliability of the power system. There are various devices like D-STATCOM, DVR and UPQC which are being used to eliminate different power quality problems.

In this thesis, a three-phase, three leg D-STATCOM structure has been studied and analyzed. Conventional control theories viz. Synchronous Reference Frame Theory (SRFT) and Power Balance Theory (PBT) have been implemented in simulation model in MATLAB using SIMULINK and Sim Power System (SPS) toolboxes. Experimental verification of PBT has also been presented. The schemes have been modeled using Sim Power Systems and performance of D-STATCOM is studied for variety of loads under varying load conditions.

The conventional control is replaced by Fuzzy logic controller (FLC) and simulation results are presented for the system with different set of rules. 49, 25 and 9 rule based FLC controllers have been designed and their performance studied for the same system over a wide variation in loading conditions. The performance of FLC is compared with PI controller. FLC requires high computational time therefore Adaptive Neuro-Fuzzy (ANFIS) controller is also designed and studied. Using suitable inputs, error and change in error over the DC link voltage, ANFIS controller is first trained. Once the performance of the ANFIS controller is satisfactory, the rule base developed by it is used for D-STATCOM control. The entire control scheme is simulated in MATLAB environment and also tested experimentally for a prototype system.

The results of different control schemes such as conventional (SRFT and PBT), soft computing techniques like fuzzy and ANN have been used for D-STATCOM control in

this thesis work. Power quality problems such as harmonic reduction, power factor correction, load balancing and voltage regulation have been addressed.

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CONTENTS

CERTIFICATE i
ABSTRACT ii
ACKNOWLEDGEMENT iv
CONTENTS v
LIST OF FIGURES viii
LIST OF TABLES xii
LIST OF ABBREVIATIONS xiii

Chapter No.	Chapter Name	Page No.
1	**INTRODUCTION AND LITERATURE REVIEW**	**1-11**
	1.1. General	1
	1.1. Power Quality in Distribution System	3
	1.2. Power Quality Solutions	5
	1.3.1. D-STATCOM	6
	1.3.2. DVR	7
	1.3.3. UPQC	9
	1.3. Trends in Power Quality Standards	10
	1.4. Conclusion	11
2	**CONVENTIONAL CONTROL TECHNIQUES FOR D-STATCOM**	**12-34**
	2.1. General	12
	2.2. System structure	12
	2.3. Hysteresis Current Controller	13
	2.4. d-q theory control scheme	14
	2.4.1. D-STATCOM operation for power	16

factor improvement
2.4.2. D-STATCOM for voltage regulation 17
2.5. MATLAB based model and simulation results 17
2.5.1. Results for power improvement 18
2.5.2. Results for voltage regulation 20
2.6. Power Balance Control scheme 22
2.6.1. MATLAB based model and simulation results 25
2.6.1.1. Result for power factor improvement 26
2.6.1.2. Result for voltage regulation 28
2.7. Hardware Results 30
2.8. Conclusion 34
3 FUZZY LOGIC CONTROLLER 35-50
3.1. General 35
3.2. Fuzzy logic theory 35
3.3. Design of fuzzy logic rules 36
3.3.1. Fuzzification 36
3.3.2. Inference mechanism 36
3.3.3. Design of Fuzzy logic rules 36
3.3.4. Design of Fuzzy logic rules 37
3.4. MATLAB based model and Simulation results 38
3.4.1. FLC based on 49 rules 38
3.4.1.1. Results for Power factor Improvement under steady state/ dynamic conditions 40
3.4.1.1. Results for voltage regulation under steady state/ dynamic conditions 42
3.4.2. FLC based on 25 rules 43

	3.4.2.1. Results for Power factor Improvement under steady state/ dynamic conditions	45
	3.4.2. FLC based on 9 rules	47
	3.4.2.1. Results for Power factor Improvement under steady state/ dynamic conditions	48
	3.5. Conclusion	50
4	**ADAPTIVE NEURO-FUZZY BASED CONTROLLER**	**51-59**
	4.1. General	51
	4.2. Step Size Variation in Adaline	51
	4.3. Simulation results	54
	4.4. Hardware results	55
	4.5. Conclusion	59
5	**CONCLUSION AND FUTURE SCOPE OF WORK**	**60-61**
	5.1. Conclusion	60
	5.2. Future scope of work	61
REFERENCES		62
APPENDIX		65
PUBLICATION		66

LIST OF FIGURES

Fig. No.	**Description**
Fig.1.1.	Block diagram of D-STATCOM system
Fig.1.2.	Block diagram of DVR system
Fig.1.3.	Basic block diagram of UPQC
Fig.2.1.	System structure of D-STATCOM
Fig.2.2.	Switching sequence of D-STATCOM
Fig.2.3.	Block diagram of SRFT control scheme
Fig.2.4.	MATLAB model based on SRFT control algorithm
Fig.2.5.	Waveform of source voltage (v_s), source current (i_s), compensator current (i_c), load current (i_l), DC voltage (V_{dc}) and terminal voltage (V_{tm}) under steady state / unbalanced conditions (UPF mode)
Fig. 2.6.	Plot of d-component (i_{dref}) of reference current under stedy state condition
Fig. 2.7.	Source voltage (v_{sa}) and Source current (i_{sa}) waveform
Fig. 2.8.	Waveform and THD of source current (i_{sa})
Fig. 2.9.	Waveform and THD of load current (i_{la})
Fig. 2.10.	Waveform of source voltage (v_s), source current (i_s), compensator current (i_c), load current (i_l), DC voltage (V_{dc}) and terminal voltage (V_{tm}) (voltage regulation mode)
Fig. 2.11	Plot of q-component (i_{qref}) of reference current under steady state condition
Fig. 2.12.	Waveform and THD of source current (i_{sa})
Fig. 2.13.	Waveform and THD of load current (i_{la})
Fig. 2.14.	Block diagram of PBT control scheme
Fig. 2.15.	MATLAB based model of PBT
Fig. 2.16.	Plot of real load power (p_{load}) under steady state condition
Fig. 2.17.	Plot of reactive load power (q_{load}) under steady state condition
Fig. 2.18.	Waveform of source voltage (v_s), source current (i_s), compensator current (i_c), load current (i_l), dc voltage (V_{dc}), terminal voltage V_{tm} under balanced/unbalanced condition (UPF mode)
Fig. 2.19.	Waveform and THD of source current (i_{sa})

Fig. 2.20.	Waveform and THD of load current (i_{la})
Fig. 2.21.	Waveform of source voltage (v_s), source current (i_s), compensator current (i_c), load current (i_l), dc voltage (V_{dc}), terminal voltage V_{tm} under balanced/unbalanced condition (voltage regulation mode)
Fig. 2.22.	Waveform and THD of source current (i_{sa})
Fig. 2.23.	Waveform and THD of load current i_{la}
Fig. 2.24.	Steady state waveform of source current (i_{sa}), load current (i_{la}), compensator current (i_{ca}) and DC voltage (V_{dc})
Fig. 2.25.	Waveform of source current (i_{sa}), load current (i_{lc}), compensator current (i_{ca}) and DC link voltage (V_{dc}) when load is removed in phase ‘c’
Fig. 2.26.	Waveform of source current (i_{sa}), load current (i_{lc}), compensator current (i_{ca}), DC link voltage (V_{dc}) when load in phase ‘c’ added
Fig. 2.27.	Waveform of source current (i_{sa}) and source voltage (v_{sa})
Fig. 2.28.	THD of source current (i_{sa})
Fig. 2.29.	THD of load current (i_{la})
Fig. 2.30.	THD of source voltage (v_{sa})
Fig. 3.1.	Block diagram of Fuzzy Logic Controller
Fig. 3.2.	Closed Loop Response of Step Input
Fig. 3.3.	Block diagram of Fuzzy Logic Control Scheme
Fig. 3.4	Seven Rulebase for (a) input (er) (b) input (Δer) (c) output (i_{loss})
Fig. 3.5.	Result showing source voltage (v_s), source current (i_s), compensator current (i_c), load current (i_l), DC link voltage (V_{dc}) and voltage at PCC (V_{tm}) under steady state / dynamic condition (UPF mode)
Fig. 3.6.	Plot of source voltage (v_{sa}) and source current (i_{sa})
Fig. 3.7.	DC link voltage (V_{dc}) variation with time under dynamic load changes
Fig. 3.8.	Waveform and THD of source current (i_{sa})
Fig. 3.9.	Results showing source voltage (v_s), source current (i_s), compensator current (i_c), load current (i_l), DC link voltage (V_{dc}) and voltage at PCC (V_{tm}) under steady state / dynamic condition (voltage regulation)

Fig. 3.10.	Waveform and THD of source current (i_{sa})
Fig. 3.11.	FLC based on five rules (a) Input (er) (b) Input (Δer) (c) Output variables
Fig. 3.12.	Result showing source voltage (v_s), source current (i_s), compensator current (i_c), load current (i_l), DC link voltage (V_{dc}) and voltage at PCC (V_{tm}) under steady state / dynamic condition (UPF mode)
Fig. 3.13.	Waveform and THD waveform of source current (i_{sa})
Fig. 3.14.	Plot of DC link voltage (V_{dc}) with dynamic load changes with 25 rule FLC
Fig. 3.15.	FLC based on three rules (a) Input (er) (b) Input (Δer) (c) Output variables
Fig. 3.16.	Results of source voltage (v_s), source current (i_s), compensator current (i_c), load current (i_l), DC link voltage (V_{dc}) and voltage at PCC (V_{tm}) for power factor improvement under steady state/dynamic conditions
Fig. 3.17.	DC link voltage (V_{dc}) plot under steady state / dynamic conditions
Fig. 3.18.	Waveform and THD of source current (i_{sa})
Fig. 4.1.	Block diagram of ANFIS based on Adaline algorithm
Fig. 4.2.	Block Diagram of Adaptive Neuro-Fuzzy for estimating variable step size
Fig. 4.3.	Adaptive Neuro-Fuzzy rules (9 rules)
	Waveforms of source voltage (v_s), source current (i_s), compensator current (i_c), load current (i_l), DC bus voltage (V_{dc}) and terminal voltage (V_{tm}) under steady state and unbalance conditions
Fig. 4.4.	Waveforms of source voltage (v_s), source current (i_s), compensator current (i_c), load current (i_l), DC bus voltage (V_{dc}) and terminal voltage (V_{tm}) under steady state and unbalance conditions
Fig. 4.5.	Plot for source voltage (v_{sa}) and source current (i_{sa})
Fig. 4.6.	Waveform and THD of source current (i_{sa})
Fig. 4.7.	Waveform and THD of load current (i_{la})
Fig. 4.8.	Three phase source voltage (v_s) waveform

Fig. 4.9.	THD of source voltage (v_s)
Fig. 4.10.	Three phase source current (i_s) waveform
Fig. 4.11.	THD of source current (i_s)
Fig. 4.12.	Three phase load current (i_l) waveform
Fig. 4.13.	THD of Load current (i_l)
Fig. 4.14.	Plot of source voltage (v_{sa}) and source current (i_{sa})
Fig. 4.15.	Plot of source voltage (v_{sa}) and load current (i_{la})

LIST OF TABLES

Table No.	Description
Table 1.1.	Total Energy Installed Generating Capacity
Table 1.2.	Electricity Consumption Sector Wise Utilities and Non Utilities
Table 3.1.	Fuzzy logic controller rules for seven rule base (49 rules)
Table 3.2.	Fuzzy logic controller rules for five rule base (25 rules)
Table 3.3.	Fuzzy logic controller rules for three rule base (9 rules)
Table 3.4.	Comparative analysis of different fuzzy rules

LIST OF ABBREVIATIONS

DSTATCOM	Distribution static compensator
DVR	Dynamic voltage restorer
UPQC	Unified power quality conditioner
MOSFET	Metal oxide field effect transistor
IGBT	Insulated gate bipolar transistor
GTO	Gate turn off
SRFT	Synchronous reference frame theory
PBT	Power balance theory
SPS	Sim power system
VSC	Voltage source converter
HCC	Hysteresis current controller
PWM	Pulse width modulation
PHF	Parallel hybrid filter
PF	Passive filter
TDD	Total distortion demand
THD	Total harmonic distortion
PCC	Point of common coupling
PFC	Power factor correction
UPF	Unity power factor
ZVR	Zero voltage regulation
FLC	Fuzzy logic controller
NL	Negative large
NM	Negative medium
NS	Negative small
Z	zero
PL	Positive large
PM	Positive medium
PS	Positive small
ANFIS	Adaptive neuro-fuzzy inference system
ADALINE	Adaptive linear network