M.TECH THESIS
ON

SOME INVESTIGATIONS ON GRID CONNECTED PV SYSTEMS

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CERTIFICATE

This is to certify that the report entitled *"**Some Investigations on Grid connected PV Systems**"* submitted by **Divya Jain** is her original work carried out by her under my supervision and guidance in partial fulfillment of the requirements for the award of the degree of Master of Technology in Power System during the session 2013-2015 in the department of Electrical Engineering, Delhi Technological University, Delhi.

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ABSTRACT

This thesis investigates the grid connected LCL interfaced solar PV system. The application of various control algorithms for controlling multifunctional voltage source converter used in the grid connected PV system are explored. The proposed schemes are designed and modeled on MATLAB platform. The first case deals with the design and analysis of LCL filter for interconnection with grid connected PV system. The proposed LCL filter based scheme improves stability of the system as well as more cheaper as compare to conventional LC filter. The LCL filter also reduce the harmonic components significantly and also shows better attenuation performance in the switching harmonics in the system as compare to conventional interfacing inductor based scheme.

The second case presents the control algorithms for LCL filter interfaced grid connected power quality improved solar PV system. The scheme is suitable for grid connected solar PV system deals with nonlinear loads typically rectifier loads, battery charging loads laptops and uninterrupted power supplies etc.

The scheme uses a three leg IGBT base voltage source converter with a capacitor on its DC link. This converter compensates harmonic and fundamental reactive power of the system. It ensures the grid has minimum harmonics while grid is feeding highly nonlinear loads. A conventional synchronous reference frame theory based control algorithm is successfully modeled and simulated to validate the proposed scheme.

An improvement of the above scheme to obtain the adaptability and improved steady state performance is developed using Anti-Hebbian control algorithm based neural network scheme. This scheme has the learning ability which makes the system adaptable to the system parameter variations.

TABLE OF CONTENTS

Certificate i

Acknowledgment ii

Abstract

Table of Contents

List of Figures

List of Tables

List of Symbols

CHAPTER – I INTRODUCTION

1.1 General 1

1.2 Scope of Work 1

1.2.1 Design and modeling of PV system, three phase inverters and LCL filters along with their frequency response analysis 1

1.2.2 Design and analysis of closed loop control for the proposed grid-LCL interfaced PV system using PI and PR controllers 2

1.2.3 Control of grid-LCL interfaced PV system 2

1.3 Outline of Chapters 2

CHAPTER – II LITERATURE REVIEW

2.1 General 4

2.2 Significant Developments in area of PV-Grid Interconnected Systems 4

2.3 Significant Developments in analysis of LCL Interfaced PV-Grid Interconnected Systems 4

2.4 Significant Developments in Analysis of Closed Loop Control using PR And PI Controllers for LCL Interfaced PV-Grid Interconnected Systems 5

2.5 Significant Developments in Control Schemes for Three Phase Inverter in PV-Grid Interconnected Systems 5

2.6 Identified Research Areas 5

2.7 Conclusions 6

CHAPTER III DESIGN OF PHOTOVOLTAIC ARRAY AND THREE PHASE INVERTER FOR A GRID INTEGRATED PV-SYSTEM

3.1 General 7

3.2 System Description and Working Principle 7

3.3 Basics of PV-System 8

3.3.1 PV Module 8

3.3.2 Layout of MPPT 9

3.3.3 DC-DC Converter 10

3.3.4 MPPT Algorithm 11

3.3.4.1 Incremental Conductance Algorithm for MPPT 11

3.4 Design of PV System 12

3.5 Design of Boost Converter for Solar Energy Conversion 13

3.6 Design of the Three Phase Inverter 14

3.6.1 Selection of DC Bus Capacitor (C_{dc}) 15

3.6.2 Selection of Interfacing Inductor (L_1) 15

3.7 Observation and Results 16

3.7.1 P-V characteristic of PV array with irradiance level of 1000 W/m^2 and 500 W/m^2 16

3.7.2 I-V characteristic of PV array with irradiance level of 1000 W/m^2 and 500 W/m^2 17

3.7.3 P-V characteristic of PV array with changes in Temperature level 19

3.8 Conclusions 20

CHAPTER IV DESIGN AND ANALYSIS OF LCL FILTER FOR INTERCONNECTION WITH GRID CONNECTED PV SYSTEM

4.1 General 21

4.2 Types of Filters 21

4.2.1 L Filter 21

4.2.2 LC Filter 22

4.2.3 LCL Filter 22

4.3 LCL Filter Design issues and damping 23

4.4 Design of LCL Filter 24

4.5 LCL Filter Damping Configurations 27

4.5.1 Damping using series resistance 27

4.5.2 Damping using parallel resistance 28

4.5.3 Parallel Damping with a combination of inductance and resistance 29

4.6 LCL Filter Stability Plots 30

4.6.1 Analysis of series resistive damping 30

4.6.1.1 When R_d=0.01 Ω 31

4.6.1.2 When R_d=0.5 Ω 31

4.6.1.3 When R_d=1Ω 32

4.6.1.4 When R_d=10 Ω 32

4.6.2 Analysis of parallel resistive damping 33

4.6.2.1 When R_d=1Ω 34

4.6.2.2 When R_d=10Ω 34

4.6.2.3When R_d=100Ω 35

4.6.2.4 When R_d=500Ω 35

4.6.2.5 When R_d=1000Ω 35

4.6.3 Analysis of damping with parallel combination of inductance and resistance 36

4.6.3.1 When R_d=10Ω and L_d=1mH 37

4.7 Conclusion 37

CHAPTER V ANALYSIS OF GRID-LCL FILTER INTERFACED PV-ARRAY SYSTEM

5.1 General 39

5.2 Closed Loop Control 39

5.3 Proposed System With PI (Proportional+Integral) Controller 44

5.4 Proposed System With PR (Proportional+Resonant) Controller 45

5.5 Observation and Analysis of Controllers 47

5.6 Conclusions 52

CHAPTER VI CONTROL ALGORITHMS FOR LCL FILTER INTERFACED GRID CONNECTED SOLAR PV SYSTEM USING POWER BALANCE THEORY

6.1 General 53

6.2 System Configuration and Working Principle 53

6.3 Synchronous Reference Theory Based Control Algorithm for Power Quality Improvement using Three Phase Inverter 54

6.3.1 Estimation of In-phase Component of Reference Source Currents 54

6.3.2 Estimation of Quadrature Component of References Source Currents 55

6.3.3 Estimation of Reference Source Currents 56

6.4 Anti-Hebbian Control Algorithm for Power Quality Improvement using Three Phase Inverter 57

6.4.1 Anti-Hebbian learning 57

6.4.2 Mathematical model of the Anti-Hebbian control algorithm for the proposed system 57

6.5 Results and Discussion 60

6.5.1 Simulation study of the proposed system with SRF control algorithm 60

6.5.2 FFT Analysis using SRF control 63

6.5.3 Simulation study of the proposed system using Anti-Hebbian control algorithm 65

6.5.4 FFT Analysis using Anti-Hebbian control algorithm 69

6.6 Conclusions 71

CHAPTER VII CONCLUSIONS

7.1 General 73
7.2 Scope for Future Work 74

REFERENCES

LIST OF FIGURES

Fig 3.1	Topology of the grid integrated PV system	8
Fig.3.2	Single-diode model of the ideal PV cell and equivalent circuit of a practical PV device including the series and parallel resistances	8
Fig 3.3	Block diagram of MPPT system	9
Fig.3.4	I-V characterstic curve for a PV panel at different insolation levels	9
Fig.3.5	I-V characterstic curve for a PV panel at three points: short circuit $(0,I_{sc})$, maximum power point (V_{mp},I_{mp}) and open circuit $(V_{oc},0)$	10
Fig 3.6	Circuit diagram of Boost Converter	10
Fig 3.7	PV characteristic curve of PV Module	11
Fig.3.8	P-V characteristic curve of PV array at irradiance level of 1000W/m^2 (Temp=298K)	17
Fig.3.9	P-V characteristic curve of PV array at irradiance level of 500W/m^2 (Temp=298K)	17
Fig.3.10	I-V characteristic curve of PV array at irradiance level of 1000W/m^2(Temp=298K)	18
Fig.3.11	I-V characteristic curve of PV array at irradiance level of 500W/m^2(Temp=298K)	18
Fig.3.12	P-V characteristic curve of PV array at temperature=273 K and irradiance level of 1000W/m^2	19
Fig.3.13	P-V characteristic curve of PV array at temperature=323 K and irradiance level of 1000W/m^2	19
Fig.4.1	Configuration of L filter	21
Fig.4.2	Configuration of LC filter	22
Fig.4.3	Configuration of LC filter	23
Fig.4.4	Topology of the proposed LCL filter based PV-Grid integrated system	23
Fig.4.5	Single phase network equivalent of LCL filter	24
Fig.4.6	LCL filter algorithm	26
Fig.4.7	Bode Plot of LCL filter	26
Fig.4.8	Bode Plot of L filter and LCL filter	27

Fig.4.9	Single Phase network equivalent of LCL filter with series damping provision	28
Fig.4.10	Single Phase network equivalent of LCL filter with parallel damping provision	28
Fig.4.11	Single Phase network equivalent of LCL filter damping with parallel combination of inductance and resistance	29
Fig.4.12	Bode plot of LCL filter with series resistive damping with R_d=0.01Ω	31
Fig.4.13	Bode plot of LCL filter with series resistive damping with R_d=0.5Ω	32
Fig.4.14	Bode plot of LCL filter with series resistive damping with R_d=1Ω	32
Fig.4.15	Bode plot of LCL filter with series resistive damping with R_d=10Ω	33
Fig.4.16	Combined bode plot of LCL filter with series resistive damping	33
Fig.4.17	Bode plot of LCL filter with parallel resistive damping with R_d=1Ω	34
Fig.4.18	Bode plot of LCL filter with parallel resistive damping with R_d=10Ω	34
Fig.4.19	Bode plot of LCL filter with parallel resistive damping with R_d=100Ω	35
Fig.4.20	Bode plot of LCL filter with parallel resistive damping with R_d=500Ω	35
Fig.4.21	Bode plot of LCL filter with parallel resistive damping with R_d=1000Ω	36
Fig.4.22	Combined bode plot of LCL filter with parallel resistive damping	36
Fig.4.23	Bode plot of LCL filter with parallel combination of inductance and resistance	37
Fig.5.1	Single phase representation of the inverter section of the proposed topology	39
Fig.5.2	Single phase representation of the grid section of the proposed topology	40
Fig.5.3	Single phase representation of the filter section of the proposed topology	40
Fig.5.4	Single phase representation of grid-LCL interfaced PV-array system	41
Fig.5.5	Block diagram of the single-phase grid connected inverter with current regulation loops	43
Fig.5.6	Current control scheme for PV-grid integrated system	43

Fig.5.7	Bode Plot of PI controller	44
Fig.5.8	Bode Plot of ideal PR Controller	46
Fig.5.9	Bode Plot of non-ideal PR Controller	46
Fig.5.10	Bode plot of the system with PI controller with K=20, K_p=2,K_i=10	48
Fig.5.11	Bode plot of the system with PI controller with K=1, K_p=2,K_i=10	48
Fig.5.12	Bode plot of the system with PI controller with K=1 and K=20	49
Fig.5.13	Bode plot of the system with PR controller with K=20, K_p=2,K_i=10	49
Fig.5.14	Bode plot of the system with PR controller with K=1, K_p=2,K_i=10	50
Fig.5.15	Bode plot of the system with PR controller with K=1 and K=20	51
Fig.5.16	Bode plot of the system with both PI and PR controllers with K=1	51
Fig.6.1	Topology of the proposed LCL filter based PV-Grid integrated system	54
Fig.6.2	Block Diagram of SRF control algorithm	55
Fig.6.3	Anti-Hebbian learning	57
Fig.6.4	Block diagram Anti-Hebbian control algorithm	59
Fig.6.5	Waveforms of V_{RYB}(source), I_{RYB}(source), I_{LRYB}, I(inverter), V_{dc}, P_{pv} with SRF control algorithm at steady state and unbalance loading conditions at irradiation level of 1000 W/m^2	61
Fig.6.6	Waveforms of V_{RYB}(source), I_{RYB}(source), I_{LRYB}, I(inverter), V_{dc}, P_{pv} with SRF control algorithm at steady state and unbalance loading conditions at irradiation level of 500 W/m^2	61
Fig.6.7	Waveforms of P,Q(source), P_{pv}, P,Q(load) with SRF control algorithm at steady state and unbalance loading conditions at irradiation level of 1000 W/m^2	62
Fig.6.8	Intermediate signals (i_{ddc}, i_{loss} and i_d^*) with SRF control algorithm at steady state and unbalance loading conditions at irradiation level of 1000 W/m^2	62
Fig.6.9	FFT Analysis of source current (i_R) using SRF control algorithm	63
Fig.6.10	FFT Analysis of source voltage (V_R) using SRF control algorithm	63
Fig.6.11	FFT Analysis of load current (i_{LR}) using SRF control algorithm	64
Fig.6.12	FFT Analysis of inverter current (i_{Rinv}) using SRF control algorithm	64

Fig.6.13 Waveforms of V_{RYB}(source), I_{RYB}(source), I_{LRYB}, I(inverter), V_{dc}, P_{pv} with Anti-Hebbian control algorithm at steady state and unbalance loading conditions at irradiation level of 1000 W/m^2 65

Fig.6.14 Waveforms of V_{RYB}(source), I_{RYB}(source), I_{LRYB}, I(inverter), V_{dc}, P_{pv} with Anti-Hebbian control algorithm at steady state and unbalance loading conditions at irradiation level of 500 W/m^2 66

Fig.6.15 Waveforms of P,Q(source), P_{pv}, P,Q(load) with Anti-Hebbian control algorithm at steady state and unbalance loading conditions at irradiation level of 1000 W/m^2 67

Fig.6.16 Weight signals for three phases R,Y,B 68

Fig.6.17 Intermediate signals (w_{pa}, i_{dc}, w_p) with Anti-Hebbian control algorithm 68

Fig.6.18 Waveforms of active unit templates for three phases R,Y,B 69

Fig.6.19 FFT Analysis of source current (i_R) using Anti-Hebbian control algorithm 69

Fig.6.20 FFT Analysis of source voltage (V_R) using Anti-Hebbian control algorithm 70

Fig.6.21 FFT Analysis of load current (i_{LR}) using Anti-Hebbian control algorithm 70

Fig.6.22 FFT Analysis of inverter current (i_{Rinv}) using Anti-Hebbian control algorithm 71

LIST OF TABLES

3.1 Values of parameters used to design the pv-inverter system

3.2 Values of parameters used to design the three phase inverter system

4.1 Table values of lcl filter parameters

4.2 Comparison of series damping for different values of R_d

4.3 Comparison of parallel damping for different values of R_d

5.1 Values of parameters used in the calculations

6.1 Values of parameters used for simulation study

6.2 THD% of each phase with SRF control algorithm

6.3 THD% of each phase with Anti-Hebbian control algorithm

LIST OF SYMBOLS

I_{sc}	Short-circuit PV current
$I_{pv,n}$	Current generated by sunlight in nominal condition
V_{oc}	Open-circuit PV voltage
N_s	No. of series connected cells in PV module
N_p	No. of parallel connected cells in PV module
K	Boltzman Constant
q	Electron charge
a	diode ideality constant, $1 \leq a \leq 1.5$
R_s	Resistance of each cell connected in series
R_p	Resistance of each cell connected in parallel
T_n	Nominal temperature in Kelvin
E_g	Bandgap energy of semiconductor
G_n	Nominal irradiation
V_{dc}	Voltage across the DC link capacitor
V_{DC}	(Input voltage to Boost Converter
I_{DC}	Input current to Boost Converter
f_{sw}	Switching Frequency
D	Duty Cycle
L_B	Boost Inductor
V_{dc}	Voltage across the DC link capacitor
I_{dc}	DC link capacitor current
S_{KVA}	KVA Rating of inverter
f_{sw}	Switching Frequency
D	Duty cycle
m	Modulation Index
C_{dc}	DC-link capacitance
L_1	Interfacing inductance at inverter side
I_{cr}	Current ripple
L_1	Inductance at the inverter end
L_g	Grid-side inductance
C_f	Filter Capacitance
L_1	Inductance at the inverter end

L_g	Grid-Side Inductance
C_f	Filter Capacitance
ω_0	AC Frequency in rad/s^2
K_p (	Proportional Gain
K_i	Integral Gain