SLIDING MODE CONTROL FOR PARALLEL INVERTERS OF DISTRIBUTIVE ENERGY RESOURCES IN MICROGRID

BY

MUHAMMAD ALI

01-244162-024

SUPERVISED BY

DR. MUHAMMAD AAMIR

Session-2016-18

A Report submitted to the Department of Electrical Engineering

Bahria University, Islamabad

in partial fulfilment of the requirement for the degree of MS(EE)

CERTIFICATE

We accept the work contained in this report as a confirmation to the required standard for the partial fulfilment of the degree of MS (EE).

____________________	____________________
Head of Department	Supervisor
____________________	____________________
Internal Examiner	External Examiner

DECLARATION OF AUTHORSHIP

I hereby acknowledge that this thesis is my own work and contains no materials previously submitted for a degree or diploma in any institution or university of higher education. To the best of my knowledge, it contains no material previously published or written by another person except where due reference is made in the text; or contain any defamatory material.

Student's Signature: ________________________

Name (In Capital): _________________________

Date: ____________________________________

ACKNOWLEDGEMENTS

My sincere gratitude goes to my supervisor, Dr. Muhammad Aamir for his encouragement, skilled guidance, critical reviews, continuous support and wide knowledge. I would also like to thanks Dr. Asad Waqar for his guidance and provide me necessary support throughout my research journey.

I am also grateful to my class fellows and friends (Ahmed, Bilal, Aziz, Ali, Adil, Haseeb, Mohsin & Hussain) for their immense support and optimism they provided me, also for being my surrogate family during my research study. Finally, I would like to thanks Engr. Abdul Aziz Khan for his help and sharing valuable information with me.

ABSTRACT

The inverter-based distributed generation (DG) units in Microgrid calls for robust control techniques that attain high performance not only during normal operating conditions but also under unbalanced conditions. Microgrid contains a cluster of loads along with distributed generators operating as a unified controlled system. Interconnecting DGs with a grid using power electronic converters has enhanced concerns regarding safe operation and protection of the equipment. Many control strategies have been proposed for enhancing the stability of microgrid for proper load sharing. This work proposes two separate controllers based on the sliding mode control for an autonomous mode and grid-tied mode of operation. Frictional-Order Sliding Mode Voltage Control (FOSMVC) technique is developed for single and parallel voltage source inverter (VSI) in autonomous mode maintains the quality of the output voltage of the DG system despite unbalanced and/or non-linear load currents. Also, this controller improves the steady state and dynamic response under sudden load fluctuation. Droop control approach and virtual output impedance (VOI) loop are investigated to guarantee the accurate power-sharing among DG units in parallel operation. Sliding Mode Current Control (SMCC) approach is adopted for the grid-tied mode where the controller works as a current controller. The proposed controller effectively abandons the grid voltage disturbances and the parameter uncertainties. Furthermore, PQ sharing control is designed for the parallel operating of DG units by delivering available power to the grid side in order to ensure power-sharing requirements. The stability of the proposed controllers is proven by applying the Lyapunov stability theorem. Both controllers have been simulated in the real-time domain of Simulink/MATLAB environment. Finally, the performance of the proposed FOSMVC is compared with the conventional proportional integral (PI) controller. The simulation results show the THD of the output voltage of 0.40% and 1.53% for FOSMVC, and 1.82% and 6.84% for PI controller under linear and nonlinear load, respectively. The results also validate that the proposed control technique is quite effective due to its robust response and less sensitive to external disturbances.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES