Abstract

Due to increased electricity energy demand and shortage of fossil fuels reserves motivated researchers to focus on renewable energy sources and photovoltaic (PV) power generation because of its benefits like pollution free, less maintenance, no noise. This thesis is focused on improvement of tracking performance of maximum power point tracking (MPPT) algorithms and development of MPPT algorithms with single sensors to reduce the overall cost of the PV systems.

The maximum power point tracking efficiency of the PV system primarily depends on the operating point on the V-I characteristics curve of the PV module. To improve the efficiency of the PV system large number of MPPT algorithms have been developed. Among the existing MPPT algorithms, perturb and observe (P&O) and hill climbing (HC) algorithms are the most widely used because of its simple and efficient tracking performance under uniform insolation conditions. However, with P&O and HC method the operating point drift away from maximum power point (MPP) in case of an sudden increase in insolation. In this thesis a novel MPPT algorithm is developed to avoid this drift phenomena.

In this thesis, we concern for a efficient maximum power point tracking (MPPT) is an important problem for renewable power generation from photovoltaic (PV) systems. In this work, a current sensor based MPPT algorithm using an adaptive step-size (ASS) for a single ended primary inductance converter (SEPIC) based solar PV system is proposed. Due to lower sensitivity of power to current perturbation as compared to the voltage one, such a scheme is shown to yield better efficiency at steady-state. A new adaptation scheme is also proposed for faster convergence of the MPPT technique. Hence, the proposed scheme yields better transient as well as steady-state performance. A prototype converter is used along with digital implementation of the proposed MPPT technique to demonstrate the superiority of the proposed algorithm over the fixed step-size (FSS) and voltage based

ones. Simulation and experimental results corroborates the same.

The PV systems generally contain a battery , where the load voltage and load current are to be measured for the implementation of charge controller. Therefor by sensing only the load parameter (load voltage (V_L)), the objectives such as MPPT and charge controller can be achieved. In this thesis a load voltage based (LVB) maximum power point tracking (MPPT) technique using adaptive step-size (ASS) for standalone photovoltaic (PV) systems has been developed. The technique improves the convergence speed of the MPPT using a single voltage sensor to measure the load voltage (V_L) regardless of the nature of load type. The ASS of the MPPT controller is varied according to the slope $\left(\frac{dV_L}{dD}\right)$ of V_L versus duty ratio (D) characteristic. The effectiveness of the proposed technique is tested for different insolation level conditions. This ASS based control scheme improves the convergence performance over fixed step-size (FSS) scheme under varying insolation condition. A single-ended primary inductance converter (SEPIC) is used for interfacing the PV system with the resistive load, which increases the operating range of the PV system. The tracking performance of the proposed technique is compared with FSS MPPT, perturb and observe (P&O) and incremental-conductance (IncCond) techniques by simulation. Experimental verification using a developed laboratory prototype is also carried out.