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MODELLING AND PERFORMANCE EVALUATION OF MPPT BASED SOLAR PV SYSTEM WITH DIFFERENT INTERFACES in MATLAB/SIMULINK ENVIRONMENT

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Abstract

In photovoltaic system electricity is generated through solar cell. A single cell generates very minimal power. Several such cells are suitably connected to obtain feasible value of power. Such an arrangement is called as module. Several such arrangements are again suitably connected to get desired power. In this study, analysis of a photovoltaic (PV) system is carried out to obtain maximum power output under fixed radiation and variable temperature condition. The modelled system consists of three different parts broadly. First one is the generation part which is formed by a solar PV array. The second part is a power electronic interface. For the present study, the system is taken to be a dc system and hence the interface is a DC-DC converter. Three such DC-DC converters are analyzed in the present study. The third part is the load which is taken to be a pure resistance in the study as the system is a DC system. It is evident that the output of a PV system is depended on solar irradiation falling on the PV arrangement as well as the ambient temperature. Therefore, the system will be more effective if it is operated on the maximum power point. In this regard, the power electronic interface helps the system for maximum power point tracking (MPPT). In present study, a controller based on Perturb and Observe (P&O) method is used to control the duty ratio of the power electronic interface so that the system run-on maximum power point position.

Keywords: Sustainability, PV array, MPPT Controller, DC-DC converter, Perturb and Observe (P&O) method.

1. Introduction

Energy is the main factor to keep civilization alive. Development and technical advancement require harnessing of energy in different forms. According to the law of conservation of energy it cannot be created, nor destroyed and can only be converted to a suitable form. Different techniques require different form of energy and electricity is the most useful and compact among all other forms. Electricity can easily be converted to any desirable form through suitable appliances. However, the major constraint of energy conversion is heat loss. Energy resources can be categorized as renewable and non-renewable. Nonrenewable resources are basically fossil fuel-based resources which are finite by nature. On the other hand, renewable resources are abundant in nature such as solar (PV and solar-thermal), wind, biomass, hydel power, tidal, ocean thermal, geothermal etc. Major advantage of fossil fuel is that its energy density is very high along with existence of several well-established energy harnessing techniques. On the other hand, the polluting nature of such resources supersedes these advantages from sustainability point of view. On the contrary to the non-renewable resources, the renewable resources are finite by nature with low energy density along with eco-friendly nature of harnessing. It is evident that fossil fuel-based resources will not sustain in future if they are extracted in the present rate [1] and this gained the attention of researchers since last century. However, proper energy harnessing is related directly with per capita energy consumption which has to be maintained in a proper level in order to enhance the economic growth [2-5]. In this regard integration of various renewable resources in the existing energy system forms an optimized mixture of energy which helps in achieving sustainability through different modes such as cogeneration [6-8], energy efficiency [9-11], energy conservation [12-14], energy management [15-18] etc.

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