

Modeling, Simulation and Performance Characteristics of DC Series Motor Powered by Photovoltaic and DC Shunt Generators

M. S. Widyan and A. M. Harb

Abstract

This paper presents the dynamical model, simulation and performance characteristics (dynamic and steady-state) of a hybrid powered DC series motor. The sources are DC shunt generator in parallel with PV generator. The number of series and parallel modules of the PV generator are chosen to have their Maximum Power Point (MPP) at full solar illumination at the rated conditions of the DC series motor. The mathematical model and numerical simulations are elaborated for three feeding cases. To guarantee the reliability of the system, the DC shunt generator can handle all motor power requirements. As the solar illumination decreases, the DC shunt generator provides the shortage of power needed by the motor. The electromechanical system of the DC shunt generator is incorporated with state feedback control system which adjusts the mechanical driving torque of the generator in order to keep constant terminal voltage at all practical loading conditions. The dynamic study comprises successive step changes in the static load coupled to the motor at different realistic solar illuminations. The nonlinearities of the DC series motor, DC shunt generator and that of the output characteristics of the PV generator are all taken into account.