(1)

Modeling and Simulation of Fuel Cell Electric Vehicles

Mazen Abdel-Salam, Adel Ahmed, Ahmed Elnozahy and Ahmad Eid

Abstract:

Abstract - The objective of this paper is to develop a model for a fuel cell hydrogen vehicle driven by a brushless DC motor. A two leg directly coupled interleaved boost converter is used to power the motor from the fuel cell through a three-phase inverter. The studied system of the fuel-cell vehicle is designed and simulated using the commercial PSIM9 software. Due the presence of power converters, different harmonic components exist in the system, especially in the input voltage/current to the motor. The ripple contents of current and voltage at the fuel cell output and the motor input are estimated. An active power filter is designed in order to reduce the current and voltage harmonics of brushless DC motor. The instantaneous active and reactive current components id-iq control method is used in this study to lessen the harmonic contents at the input of the Brushless DC motor to the standard values.

Keywords:

Fuel cell, BLDC motor, Interleaved boost converter, Active power filter and Hybrid vehicles.

Published In:

15th International Middle East Power Systems Conference (MEPCONâŽ12) , ,

(2)

A Cost Comparison between Fuel Cell, Hybrid and Conventional Vehicles

Ahmed Elnozahy, Ali K. Abdel Rahman, Ahmed Hamza H. Ali and Mazen Abdel-Salam

Abstract:

Abstract - The objective of this paper is to present an assessment of cost for a fuel cell hydrogen vehicle (FCV) driven by a brushless DC motor (BLDC). A two leg directly coupled interleaved boost converter is used to power the motor from the fuel cell through a three-phase inverter. The power rating of vehicle motor is calculated and subsequently the rating of the fuel cell is determined. The cost of vehicle components including fuel cell stack, boost converter, brushless DC motor and hydrogen tank is estimated. The cost of FCV, the refueling cost, the market price and the efficiency of FCV are compared with those for internal combustion engine (ICE) and hybrid electric vehicle (HEV). CO2 emission from the conventional ICE and HEV vehicles as well as the CO2 tax are compared with the proposed zero-emission FCV.

Keywords:

Fuel cell, BLDC motor, Internal combustion engine (ICE), Honda Civic Sedan(DX) and Hybrid vehicles.

Published In:

16th International Middle- East Power Systems Conference -MEPCON'2014 , ,

(3)

Performance of a PV module integrated with standalone building inhot arid areas as enhanced by surface cooling and cleaning

Ahmed Elnozahy, Ali K. Abdel Rahman, Ahmed Hamza H. Ali, Mazen Abdel-Salam, and S. Ookawara

Abstract:

tThis study investigated experimentally the performance due to automatic cooling and surface cleaningof Photovoltaic (PV) module installed on the roof of a building in hot arid area as compared with thatof a module without cooling and cleaning. The module cooling is controlled automatically according tothe rear side temperature via rejection of none-converted solar-energy to the ambient to keep the PVmodule surface temperature always close to the ambient temperature. In addition, this system controlsthe cleaning period of the module front surface. The results showed a decrease of about 45.5% and 39% inmodule temperature at front and rear faces, respectively. Consequently, the cooled and surface cleanedmodule has an efficiency of 11.7% against 9% for the module without cooling and cleaning. Moreover, themaximum output power produced by cooled and cleaned module is 89.4 W against 68.4 W for non-cooledand non-cleaned module.

Keywords:

Automatic cooling and cleaning system, Control circuit, PV module, Film of water, Bernoulli equation

Published In:

Energy and Buildings , 88 , 100-109

(4)

Thermal/Electrical Modeling of a PV Module as Enhanced by Surface Cooling

A. Elnozahy, Ali K. Abdel Rahman, Ahmed Hamza H. Ali, Mazen Abdel-Salam, and S. Ookawara

Abstract:

The present work is aimed at developing thermal and electrical models which are capable of estimating the two dimensional thermal and electrical performance of a PV module under given meteorological conditions. The thermal modeling has been developed in COMSOL Multiphysics software environment and the electrical modeling has been carried out in PSIM software environment. The main objective of the electrical model is to investigate the I-V and P-V characteristics of an 80W thin film PV module with and without cooling at varying surface temperature and irradiation. In the thermal model, the dependence of module surface temperature, electrical efficiency, and thermal efficiency on water flow velocity is investigated. The results obtained from the proposed electrical and thermal models are validated experimentally. The results showed that the maximum electrical, thermal and net energy efficiency values of cooled PV module are 9.92%, 55.6%, and 65.4%, respectively. Variation of water flow velocity experiences no significant temperature change in the coolant water exiting the module and results in a slight change of both the module surface temperature and electrical efficiency.

Keywords:

Terms□COMSOL software, cooling system, electrical model, PSIM software, PV module, and thermal model.

Published In:

International Conference on Clean and Green Energy (ICCGE 2015) , , 279-286

(5)

Optimum Sizing of Standalone Hybrid PV/Wind Power Generation System in Egypt

Ahmed ELNOZAHY, Ali KAMEL, Mazen ABDEL-SALAM, Shinichi OOKAWARA

Abstract:

In this study, the I-V and P-V curves of PV system at different solar radiations and ambient temperatures have been determined based on five-parameter equations describing the PV module. Also, the wind turbine performance model has been developed and the predicted power-speed curves have been validated against data sheet and experimental data. Both PV module and wind turbine models have been carried out in PSIM software environment. The sizing of hybrid PV/wind/storage battery power generation system has been implemented in HOMER software environment. The sizing results demonstrate that at meteorological conditions of solar radiation, wind speed, and ambient temperature in Borg Elarab area the PV/storage battery system is more feasible than hybrid PV/wind/storage battery system. Consequently, the PV/storage battery system has Net Present Cost (NPC) of $43571 against $45232 for hybrid PV/wind/storage battery system. In addition, by using fuel cell system with PV/storage battery system the excess electricity production is reduced from 1973 kWh/yr (22.4%) to 986 kWh/yr (8.7%) and NPC is reduced from $43571to $29744 which corresponds to about 31.73% reduction in system cost.

Keywords:

PV module; wind turbine; PSIM software; HOMER; fuel cell

Published In:

15th International Conference on Sustainable Energy Technologies (SET 2016) , NULL , NULL

(6)

Bi-objective economic feasibility of hybrid micro-grid systems with multiple fuel options for islanded areas in Egypt

Farag K. Abo-Elyousr, Ahmed Elnozahy

Abstract:

The main target of this research is to allow modern distributed energy resources (DERs) to contribute effectively in the economic feasibility of hybrid renewable power generation system. There are several factors such as the net present cost (NPC), levelized cost of energy (COE), amount of greenhouse gases (GHG) emissions, and the ability of the hybrid system to meet the load at different meteorological conditions to consider when evaluating the effectiveness of hybrid generation system within microgrids. A multi-objective based optimization algorithm to reduce cost, emissions, and a combined solution between cost and emissions is investigated in this research. This research presents an approach to optimize a hybrid microgrid (HMG) system with different fuel options. The power management approach determines the optimal sizing of DERs based on ant colony optimization (ACO) algorithm. In order to find the best configuration, the obtained results are compared with genetic algorithm (GA), particle swarm optimization (PSO), and HOMER. Three isolated areas in Egypt with different metrological conditions are selected for optimization of HMG system, namely: Kharga, Saint Katherine, and Qussair. The results show that the combined optimal configuration of HMG system is better in satisfying load demands without violating any restraints.

Keywords:

Hybrid microgrids; Economic feasibility; Multi-objective; Ant colony; Greenhouse gases

Published In:

Renewable Energy , Vol. 128, Part A , pp. 37 - 56