

Nonlinear Control Based on a Combination Between Sliding Mode and Backstepping of Grid Connected Photovoltaic System

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Abstract

This paper evokes the nonlinear control of single phase grid connected to the photovoltaic system through an adaptation circuit based on a half bridge inverter and L filter. The control objectives are threefold: i) Perfect MPPT: extracting the Maximum power from the PV array by acting on the DC-DC converter ii) Unity power factor in the grid: provide a sinusoidal current in phase with the grid voltage by controlling DC/AC converter iii) Regulating the output voltage to a desired reference value. The problem is dealt with by designing a nonlinear controller using a combination between Sliding mode, Backstepping approach and Lyapunov stability based on an averaged nonlinear model of 5th order. The system configuration includes a photovoltaic generator, DC-DC converter, DC-AC half bridge inverter coupled to grid. The system is controlling via the input control of the DC-DC converter and DC-AC inverter. The majorities of works that deal with this system were based on the inverter controlled by the Backstepping approach or the sliding mode approach, while this work processes the command through a combination of both, and make improvement in the phenomenon of chattering. The half bridge inverter present many advantage, such as the low cost because reducing of number of interrupters and the current in output is the double compared to the inverter half-bridge. The simulation results have been performed through Matlab/Simulink environment and show that the designed controller meets its objective.

Keywords

Grid-connected photovoltaic system; half bridge inverter; Maximum power point tracking (MPPT); Unity power factor; combination Backstepping & sliding mode controller.

Biography

Lissane Elhaq Saâd is professor at ENSEM (National School of Electricity and Mechanics, Casablanca, Morocco). S. Lissane Elhaq received the Ph.D. degree from the University of Nancy I, France, in 1990, and he also has a Doctorate in Automation and Computer Science from the EMI (School of Engineering Mohamadiah), Morocco, obtained in 1998.

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Lachkar Ibtissam is professor at ENSEM (National School of Electricity and Mechanics, Casablanca, Morocco). She received the Doctorat in Automatic from the EMI (School of Engineering Mohamadia), Morocco, obtained in March 2011. She is currently researcher in LRI (Laboratory of Engineering Research) and part of the optimization of production system & energy team at University Hassane II, Superior National School of Electricity and Mechanics ENSEM in Casablanca. His research interests include: advanced nonlinear control of power converters, renewable energies, power quality...

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