ASEC 2022

Abstract

Robust Nonlinear Control of Maximum Power Point Tracking in PV Solar Energy System under Real Environmental Conditions †

Ambe Harrison [1]*, Jean de Dieu Nguimfack Ndongmo [2] and Njimboh Henry Alombah [3]

[1] Department of Electrical and Electronics Engineering, College of Technology (COT), University of Buea; ambeharrison2000@gmail.com
[2] Department of Electrical and Power Engineering, Higher Technical Teacher Training College (HTTTC), University of Bamenda, Bambili, P.O. Box 39, Bamenda, North-West, Cameroon; nguimfack.jean@uniba.cm
3 Department of Electrical and Electronics Engineering, College of Technology, University of Bamenda: alonjims@yahoo.com
† Presented at the 3rd International Electronic Conference on Applied Sciences; Available online: https://asec2022.sciforum.net/.

Citation: Lastname, F.; Lastname, F.; Lastname, F. Robust Nonlinear Control of Maximum Power Point Tracking in PV Solar Energy System under Real Environmental Conditions. *Eng. Proc.* **2022**, *4*, x. https://doi.org/10.3390/xxxxx

Academic Editor: Firstname Lastname

Published: 1 December 2022

Abstract: Optimization of the operational performance PV systems require tracking the PV operating point at which maximum power is available. Given that, in practice the PV system is subjected to environmental parameters, which are random in nature, continuous tracking of this point, the Maximum Power Point (MPP), becomes an absolute necessity. Numerous techniques for Maximum Power Point Tracking (MPPT) have been reported in the literature. However, these techniques suffer from numerous problems such as oscillation around the maximum power point and robust inabilities. Taking into account the nonlinear nature of the PV coupled to the nonlinear time variant nature of power electronics converters interfaced in PV systems, nonlinear control becomes a vital strategy to guarantee both an oscillation free and a robust PV-MPPT system. This work presents a nonlinear robust strategy for MPPT control of PV system using a Boost DC-DC converter. The nonlinear strategy is based on the Integral Backstepping Controller. The control system uses a trained Artificial Neural Network (ANN) to generate a reference voltage that is injected in the closed system for reference tracking. The stability of the closed system has been verified using Lyapunov functions. To ensure an effective and robust response of the closed loop system, mathematical equations derived by initializing tuning goals in the control law, have been developed. Therefore, the closed loop system formed a Robust Integral Backstepping (RIBS) control. The performance of the RIBS-MPPT system has been investigated in real environmental conditions under light as well as heavy load variations, perceived by the nonlinear controller as disturbances, while benchmarking its performance against the conventional perturb and observe (P&O). It was noted that the RIBS outperformed the P&O under all test conditions. An interesting feature of the proposed RIBS lies in its high reference tracking and zero steady-state oscillations potential under heavy disturbances in real environmental conditions. Therefore, the proposed nonlinear control scheme is suitable for effective and efficient optimization of PV systems.

Keywords: keyword 1; keyword 2; keyword