Environmental Engineering and Management Journal xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
http://www.eemj.icpm.tuiasi.ro/; http://www.eemj.eu

"Gheorghe Asachi" Technical University of Iasi, Romania

OPTIMAL DYNAMIC FRACTIONAL-ORDER CONTROL OF PHOTOVOLTAIC SYSTEM BASED ON NOVEL MULTI-STAGE MULTI-LEVEL CONVERTER IN POWER NETWORK CONNECTION STATUS

Milad Sanaie[1], Hadi Dehbovid[2]*, Seyed Saleh Ghoreishi Amiri[2], Mehdi Radmehr[1]

[1]Department of Electrical Engineering, Nour Branch, Islamic Azad University, Nour, Iran
[2]Department of Electrical Engineering, Sari Branch, Islamic Azad University, Sari, Iran

Abstract

The photovoltaic systems are commonly interconnected with the distribution power systems through power electronic converters which affect their efficiency and durability. Multi-stage power electronic converter as one of the most prominent converter types can perform AC/DC, DC/AC and AC/AC conversion to adapt the infrastructure current and voltage. The main drawback of these converters is the transferring the current and voltage with high ripple, whereas they include a large number of semiconductors which impose high switching losses. To solve the mentioned problems, this paper proposes a novel multi-stage power electronic converter which consists of T-type inverter and dual-output boost converter with low switch count. The performance of proposed converter has been thoroughly compared with other conventional and innovative converters in terms of number of semiconductor , leakage current, total harmonic distortion and efficiency. To accurately extract the maximum power from the multi-stage power electronic converter-based photovoltaic power generation system, its tracker has been equipped with dynamic fractional-order perturbation & observation that its parameters have been optimally tuned by flower pollination optimization algorithm. To validate the simulation results, the DSP28335 prototype model of the proposed multi-stage multi-level converter has been structured and experimented in laboratory.

Key words: dynamic variable fractional-order perturbation & observation, hunter pray optimization algorithm, leakage current, multi-stage power electronic converter, photovoltaic system, power losses

Received: May, 2024; Revised final: October, 2024; Accepted: October, 2024

* Author to whom all correspondence should be addressed: e-mail: dehbovidhadi@gmail.com