Releasable Kinetic Energy-Based Inertial Control of a DFIG Wind Power Plant

Wind turbine generators (WTGs) in a wind power plant (WPP) contain different levels of releasable kinetic energy (KE) because of the wake effects. This paper proposes a releasable KE-based inertial control scheme for a doubly fed induction generator (DFIG) WPP that differentiates the contributions of the WTGs depending on their stored KE. The proposed KE-based gain scheme aims to make use of the releasable KE in a WPP to raise the frequency nadir. To achieve this, two additional loops for the inertial control are implemented in each DFIG controller: the rate of change of frequency and droop loops. The proposed scheme adjusts the two loop gains in a DFIG controller depending on its rotor speed so that a DFIG operating at a higher rotor speed releases more KE. The performance of the proposed scheme was investigated under various wind conditions. The results clearly indicate that the proposed scheme successfully improves the frequency nadir more than the conventional same gain scheme by releasing more KE stored in a WPP, and it helps all WTGs to ensure stable operation during inertial control by avoiding the rotor speed reaching the minimum speed limit.

General information
State: Published
Organisations: Department of Wind Energy, Integration & Planning, Chonbuk National University, National Renewable Energy Laboratory
Contributors: Lee, J., Muljadi, E., Sørensen, P. E., Kang, Y. C.
Pages: 279-288
Publication date: 2016
Peer-reviewed: Yes

Publication information
Journal: IEEE Transactions on Sustainable Energy
Volume: 7
Issue number: 1
ISSN (Print): 1949-3029
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 7.42 SJR 2.318 SNIP 2.452
Web of Science (2017): Impact factor 6.235
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 7.8 SJR 2.368 SNIP 2.967
Web of Science (2016): Impact factor 4.909
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 7.09 SJR 2.717 SNIP 3.22
Web of Science (2015): Impact factor 3.727
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 7.03 SJR 2.554 SNIP 3.898
Web of Science (2014): Impact factor 3.656
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 7.03 SJR 2.043 SNIP 3.712
Web of Science (2013): Impact factor 3.842
ISI indexed (2013): ISI indexed no
Web of Science (2013): Indexed yes
Scopus rating (2012): CiteScore 6.58 SJR 1.243 SNIP 3.744
ISI indexed (2012): ISI indexed no
Scopus rating (2011): CiteScore 5.13 SJR 0.73 SNIP 3.01
ISI indexed (2011): ISI indexed no
Original language: English
Keywords: Power, Energy and Industry Applications, doubly fed induction generator (DFIG), Frequency control, Frequency measurement, Generators, Inertial control, loop gain, power limit, releasable kinetic energy, Rotors, torque limit, Wind energy, Wind power generation, Wind speed