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Harmonic Compensation in Standalone Distributed Generation System

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Abstract: *This dissertation deals with a dual second-order generalized integrator based frequency locked loop (DSOGI-FLL) control approach for a standalone distributed generation (DG) system under unbalanced nonlinear load condition and varying wind speed. The DG system consists of wind driven SEIG, interfacing inductors, voltage source convertor (VSC), battery storage system (BSS) and nonlinear load. The DSOGI-FLL algorithm with enhanced filtering capability, employed for both voltages and currents, helps to attenuate the harmonics, and estimates the sequence components. This algorithm elicits the fundamental component of highly nonlinear load current required for calculating the reference magnitude of the load currents. The proposed control with VSC provides multi-functions voltage/frequency regulation of SEIG, active/reactive power support, harmonics elimination, load balancing and improve the overall power quality of the DG system. The battery storage system (BSS) is connected at dc link of the VSC to provide power support during dynamic conditions. This system is simulated in MATLAB/ Simulink environment and results are analyzed under dynamic conditions. The simulation results are observed in accordance with the standard of the IEEE-519.*

Keywords: Battery storage system, Distributed generation system, frequency locked loop

REFERENCES

[1] S. Xie, X. Wang, C. Qu, X. Wang, and J. Guo, “Impacts of different wind speed simulation methods on conditional reliability indices,” Int. Trans. Electr. energy Syst., vol. 20, no. June 2009, pp. 1–6, 2013, doi: 10.1002/etep.

[2] G. K. Kasal and B. Singh, “A STATCOM based voltage regulator for parallel operated isolated asynchronous generators feeding three-phase four-wire loads,” Int. J. Power Electron., vol. 1, no. 3, pp. 318–332, 2009, doi: 10.1504/IJPElec.2009.023625.

[3] B. Jena and A. Choudhury, “Voltage and frequency stabilisation in a micro-hydro-PV based hybrid microgrid using FLC based STATCOM equipped with BESS,” Proc. IEEE Int. Conf. Circuit, Power Comput. Technol. ICCPCT 2017, 2017, doi: 10.1109/ICCPCT.2017.8074291.

[4] N. K. S. Naidu and B. Singh, “Grid-Interfaced DFIG-Based Variable Speed Wind Energy Conversion System With Power Smoothening,” IEEE Trans. Sustain. Energy, vol. 8, no. 1, pp. 51–58, 2017, doi: 10.1109/TSTE.2016.2582520.

[5] Y. Terriche et al., “A Hybrid Compensator Configuration for VAR Control and Harmonic Suppression in All-Electric Shipboard Power Systems,” IEEE Trans. Power Deliv., vol. 35, no. 3, pp. 1379–1389, Jun. 2020, doi: 10.1109/TPWRD.2019.2943523.

[6] S. L. Prakash, M. Arutchelvi, and A. S. Jesudaiyan, “Autonomous PV-Array Excited Wind-Driven Induction Generator for Off-Grid Application in India,” IEEE J. Emerg. Sel. Top. Power Electron., vol. 4, no. 4, pp. 1259–1269, 2016, doi: 10.1109/JESTPE.2016.2579678.

[7] S. Kewat and B. Singh, “Modified amplitude adaptive control algorithm for power quality improvement in multiple distributed generation system,” IET Power Electron., vol. 12, no. 9, pp. 2321–2329, Aug. 2019, doi: 10.1049/iet-pel.2018.5936.

[8] Y. K. Chauhan, S. K. Jain, and B. Singh, “A prospective on voltage regulation of self-excited induction genezators for industry applications,” IEEE Trans. Ind. Appl., vol. 46, no. 2, pp. 720–730, 2010, doi: 10.1109/TIA.2009.2039984.

[9] S. S. Murthy and A. J. P. Pinto, “A generalized dynamic and steady state analysis of Self Excited Induction Generator (SEIG) based on MATLAB,” ICEMS 2005 Proc. Eighth Int. Conf. Electr. Mach. Syst., vol. 3, pp. 1933–

1938, 2005, doi: 10.1109/icems.2005.202898.

[10] A. K. Giri, S. R. Arya, and R. Maurya, "Compensation of Power Quality Problems in Wind-Based Renewable Energy System for Small Consumer as Isolated Loads," IEEE Trans. Ind. Electron., vol. 66, no. 11, pp. 9023–9031, Nov. 2019, doi: 10.1109/TIE.2018.2873515.

[11] S. Golestan, J. M. Guerrero, J. C. Vasquez, A. M. Abusorrah, and Y. Al-Turki, "Standard SOGI-FLL and Its Close Variants: Precise Modeling in LTP Framework and Determining Stability Region/Robustness Metrics," IEEE Trans. Power Electron., vol. 36, no. 1, pp. 409–422, 2021, doi: 10.1109/TPEL.2020.2997603.

[12] V. Narayanan, Seema, and B. Singh, "Solar PV-BES based microgrid system with seamless transition capability," 2018 2nd IEEE Int. Conf. Power Electron. Intell. Control Energy Syst. ICPEICES 2018, pp. 722–728, 2018, doi: 10.1109/ICPEICES.2018.8897358.

[13] P. Chittora, A. Singh, and M. Singh, "Adaptive EPLL for improving power quality in three-phase three-wire grid-connected photovoltaic system," IET Renewable Power Generation, vol. 13, no. 9. pp. 1595–1602, 2019, doi: 10.1049/iet-rpg.2018.5261.

[14] F. Wu and X. Li, "Multiple DSC Filter-Based Three-Phase EPLL for Nonideal Grid Synchronization," IEEE J. Emerg. Sel. Top. Power Electron., vol. 5, no. 3, pp. 1396–1403, 2017, doi: 10.1109/JESTPE.2017.2701498.

[15] S. Bhattacharyya and B. Singh, "Wind-Battery-PV Based Microgrid with Discrete Second Order Sequence Filter-Frequency Locked Loop," Proc. 2020 IEEE Int. Conf. Power, Instrumentation, Control Comput. PICC 2020, 2020, doi: 10.1109/PICC51425.2020.9362357.

[16] K. Z. Liu, A. R. Teel, X. M. Sun, and X. F. Wang, "Model-Based Dynamic Event-Triggered Control for Systems with Uncertainty: A Hybrid System Approach," IEEE Trans. Automat. Contr., vol. 66, no. 1, pp. 444–451, 2021, doi: 10.1109/TAC.2020.2979788.

[17] A. Muhtadi, D. Pandit, N. Nguyen, and J. Mitra, "Distributed Energy Resources Based Microgrid: Review of Architecture, Control, and Reliability," IEEE Trans. Ind. Appl., vol. 57, no. 3, pp. 2223–2235, 2021, doi: 10.1109/TIA.2021.3065329.

[18] S. Golestan, J. M. Guerrero, J. C. Vasquez, A. M. Abusorrah, and Y. Al-Turki, "All-Pass-Filter-Based PLL Systems: Linear Modeling, Analysis, and Comparative Evaluation," IEEE Trans. Power Electron., vol. 35, no. 4, pp. 3558–3572, 2020, doi: 10.1109/TPEL.2019.2937936.

[19] M. Ramezani, S. Golestan, S. Li, and J. M. Guerrero, "A Simple Approach to Enhance the Performance of Complex-Coefficient Filter-Based PLL in Grid-Connected Applications," IEEE Trans. Ind. Electron., vol. 65, no. 6, pp. 5081–5085, 2018, doi: 10.1109/TIE.2017.2772164.