Cuk Supriyadi Ali Nandar, J Fundam Renewable Energy Appl, 5:6
http://dx.doi.org/10.4172/2090-4541.C1.005

OMICS International
conferenceseries.com

International Conference on
Green Energy & Expo
September 21-23, 2015 Orlando, USA

Robust and adaptive PID control design for stabilization of interconnected smart power system with high penetration of renewable energy

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When large power output renewable energy generation connected to grid, the number of conventional rotating type of generators in operation decreases which results in the reduction of total inertia constant and it makes the power system stability weak. Moreover, the uncertainty of renewable energy generations may cause the dynamic characteristic of the power system changeable. On other hand, the performance of controller depends on the dynamic characteristic of the power system. Therefore, we need to re-estimate the system to adjust controller parameters to enhance the stability of the power system. This paper proposes design of energy storage controller in interconnected power system by considering robustness and adaptivity. The structure of controller is PID controller due to the most applicable in industry, simple structure, low cost and high reliability and performance. Robustness of controller is guaranteed by taking system uncertainties such as various generating and loading conditions, system non-linearities etc into consideration. The concept of enhancement of inverse additive perturbation is formulated as the optimization problem of PID parameters. The generic algorithm is applied to solve for controller parameters. In adaptive control, the controller parameters are changed depending on the situations. However, it is not desirable that the parameters are changed too frequently. It is preferable that the parameter alteration is done at the right moment. Here a system identification technique and the robust controller design method are combined into an indirect adaptive controller design. The result of model identification is used to monitor discrepancy between output of the actual power system and output of the identified model. When a large discrepancy is detected, a new set of controller parameters is determined to adapt to the new situation. The effectiveness of proposed method is evaluated in interconnected power system with high renewable energy penetration against various line flow conditions and inertia constant in comparison with the conventional robust controller without considering adaptivity. Non linear simulation in interconnected power system confirms that the proposed controller design is effective to stabilize the system against various line flow conditions and inertia constant due to renewable energy penetration.

Biography

Cuk Supriyadi Ali Nandar received BEng degree from Electrical Engineering Department, Gadjah Mada University in 2002. He earned his MEng Degree in Electrical Engineering of King Mongkut's Institute of Technology Ladkrabang in 2009. He received DEng from Kyushu University. He is currently researcher at Agency for The Assessment and Application of Technology. His field of interests includes smart grid power system and renewable energy. He has published 2 (two) International Book Chapters, 14 International Journals and 21 International Conferences.

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