琉球大学学術リポジトリ

ハイブリッド電力システムにおける系統周波数制御と有効電力平滑化に関する研究

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Abstract

Title: **Grid Frequency Control and Active Power Leveling of Hybrid Power Systems**

(ハイブリッド電力システムにおける系統周波数制御と有効電力平滑化に関する研究)

In most remote and isolated areas, electric power is often supplied by diesel generators. Due to these environmental and economic influences of the diesel generator, interest in alternative cost-effective, sustainable, and clean energy sources has grown significantly. However, hybrid power system, especially in isolated systems with renewable energy sources such as WTG and PV, faces some stability problems because the power supplied by these sources is not constant, diverge quickly and cannot be easily predicted. So, these oscillations in the renewable power sources can produce instantaneous mismatch in the vital balance between generation and demand. Consequently, continuous variations in frequency and voltage levels usually appear which negatively affect the electric power system stability. In this thesis, five frequency control and active power leveling schemes are implemented for hybrid power systems including renewable energy sources and ESS. In the first approach, robust control approach of hybrid wind-diesel power system is discussed. Proportional-Integral-Derivative (PID) controller is designed in the blade pitch system of wind turbine to improve the system dynamic performance. In the second scheme, optimal multi-objective design of PID controller parameters for a small power system using epsilon multi-objective genetic algorithm (ε-MOGA) has been presented. The proposed scheme is applied for controlling the pitch angle system of the WTG according to four objective functions. A new frequency control scheme for a hybrid power system to ensure supplying a high-quality power in isolated areas is applied in the third methodology. The proposed power system consists of WTG, PV, AE, FC, BESS, FW, and DEG. Also, EV is implemented at the customer side. A novel polar fuzzy (PF) control scheme for hybrid power system is proposed in the fourth approach. The proposed control technique remedies the issues of system frequency and continuity of demand supply caused by renewable sources uncertainties. In the fifth approach, new methodology for controlling system frequency and power is analyzed. Two decentralized fuzzy logic-based control schemes are addressed and the standard IEEE 9-bus 3 generators system is used as test model with 25% wind penetration.

Name: Mohammed Elsayed Lotfy Elsayed Abouzeid

Mohammed Lotfy

Signature