PARAMETER OPTIMIZATION OF PITCH CONTROLLER FOR ROBUST FREQUENCY CONTROL IN AN ISOLATED WIND-DIESEL HYBRID POWER SYSTEM USING GENETIC ALGORITHM

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Abstrak

Paper ini fokus pada optimasi parameter pengendali pitch yang robust untuk meredam fluktuasi frekuensi pada sistem tenaga listrik hybrid angin-diesel di daerah terpencil. Struktur pengendali yang dipakai adalah kendali sederhana lead-lag orde 1. Untuk mejamin kehandalan pengendali, normalized coprime factorization digunakan untuk merepresentasikan ketidakpastian sistem, seperti perubahan parameter sistem dan lain-lain, pada saat pemodelan sistem. Parameter pengendali yang optimal dapat dihasilkan dengan menggunakan kondisi unjuk kerja dan kondisi stabilitas kendali H∞ loop shaping untuk menformulasikan masalah optimasi, dan algoritma genetika digunakan untuk menyelesaikan masalah optimasi tersebut. Studi simulasi digunakan untuk memperlihatkan perbandingan unjuk kerja dan kehandalan pengendali pitch antara pengendali yang diusulkan dengan pengendali variabel struktur yang diperoleh dari paper lainnya.

Kata kunci*: sistem tenaga listrik hybrid angin-diesel, kendali frekuensi robust, algoritma genetika*

Abstract

This paper focuses on the parameter optimization of the pitch controller for robust frequency control in an isolated wind-diesel hybrid power system. The structure of the pitch controller is a practical 1st–order lead-lag compensator. In system modeling, the normalized coprime factorization is applied to represent system uncertainties such as variations of system parameters etc. As a result, the robust stability of the controlled system against various uncertainties can be guaranteed. To obtain the controller parameters, the performance and stability conditions of H∞ loop shaping control are employed to formulate the optimization problem. The genetic algorithm is used to solve the problem. The frequency control effect and robustness of the proposed pitch controller against system uncertainties are evaluated by simulation studies in comparison with a variable structure pitch controller.

Keywords*: wind-diesel hybrid power system, robust frequency control, genetic algorithm*

1. INTRODUCTION

Wind power is expected to be economically attractive when the wind speed of the proposed site is considerable for electrical generation and electric energy is not easily available from the grid [1]. This situation is usually found on islands and in remote localities. Nevertheless, wind power is intermittent due to worst case weather conditions such as an extended period of overcast skies or when there is no wind for several weeks. As a result, wind power generation is variable and unpredictable. To solve this problem, the hybrid wind power with diesel generation has been suggested [2, 3].

A hybrid wind diesel system is very reliable because the diesel acts as a cushion to take care of variation in wind speed and would always maintain an average power equal to the set point. However, in addition to the unsteady nature of wind, another serious problem faced by the isolated power generation is the frequent change in load demands. This may cause large and severe oscillation of system frequency. In the worst case, the system may lose stability if