FREQUENCY DEVIATIONS STABILIZATIONS IN RESTRUCTURED POWER SYSTEMS USING COORDINATIVE CONTROLLERS

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DOCTOR OF PHILOSOPHY

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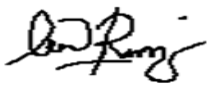

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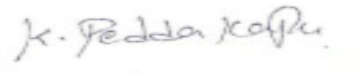

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Thesis submitted in fulfillment of the requirements
for the award of the degree of
Doctor of Philosophy

College of Engineering
UNIVERSITI MALAYSIA PAHANG

DECEMBER 2021

ACKNOWLEDGEMENTS

First and foremost, I am grateful to God for the good health and well-being necessary to complete my thesis successfully. Words are inadequate to express the overwhelming sense of gratitude and humble regards to my supervisor Dr. Mohd Rusllim Bin Mohamed, Associate Professor, College of Engineering, for his constant motivation, endorsement, expert guidance, constant supervision, and constructive suggestions for the submission of this thesis. I am extremely thankful and indebted to him for sharing his expertise, sincere and valuable guidance, and encouragement extended to me. Without his supervision, this progress would not have been completed in a timely manner.

I would like to express my sincere gratitude to Dr. Herwan Sulaiman, Associate Professor, Faculty of Electrical & Electronics Engineering, for providing the internal grant (RDU1803101) to work on research without any financial difficulties effectively. Moreover, I am also indebted to UMP for contributing financial assistance through Doctoral Research Scheme (DRS) from 2020 to date.

I also want to take this opportunity to express gratitude to all the department faculty members for their help and support especially to all panels, for contributing their comments and giving critical assessments to correct me. I express my acknowledgment towards my friends for their motivation and moral support throughout the project.

I would like to thank all who directly and indirectly supported me in completing this thesis. Finally, I would like to thank my parents, Mr. K.N. Murthy, Mrs. K. V. Bhaskara, and my sisters, Varalakshmi and Ammulu, for their unceasing encouragement, support, and attention.

ABSTRAK

Sistem tenaga yang disusun semula moden menghadapi penyimpangan frekuensi yang berlebihan kerana teknologi tenaga baharu yang terputus-putus dan permintaan beban yang terus berubah. Strategi kawalan yang cekap dan mantap harus dilakukan untuk meminimumkan penyimpangan pada frekuensi sistem dan garis-sempadan untuk mengelakkan kemungkinan pemadaman. Oleh itu, dalam penyelidikan ini, untuk mencapai sasaran ini, Kawalan Penjanaan Automatik (AGC) digunakan sebagai pengawal sekunder untuk meringankan perubahan sistem penyusunan semula yang saling berkaitan dalam keadaan yang berubah-ubah. Objektif AGC adalah untuk menstabilkan dengan cepat sebarang penyimpangan frekuensi dan daya-garis sempadan berikutan turun naik beban. Tesis ini membahas prestasi AGC dalam sistem dua-kawasan Penyusunan Semula Sistem Kuasa menggunakan pelbagai strategi kawalan canggih melibatkan penjana tenaga elektrik yang boleh diperbaharui dan tradisional. Menurut literatur penyelidikan, terdapat beberapa kajian penyelidikan mengenai AGC Penyusunan Semula Sistem Kuasa menggunakan pengawal koordinat yang dioptimumkan. Selain itu, penyelidikan mengenai pengawal koordinat-optimum yang terkini masih sedikit dalam literatur. Sehubungan dengan itu, pelbagai kombinasi pengawal dua darjah bebas (2DOF) digunakan sebagai pengawal tambahan untuk mengurangkan penyimpangan frekuensi. Walaubagaimanapun, garis-sempadan yang saling berkaitan biasanya sesak di kawasan yang menggunakan sumber tenaga boleh diperbaharui, yang menyebabkan keupayaan garis-sempadan dikurangkan. Oleh itu, pengawal Sistem Transmisi Arus Ulang-alik (FACTS) yang berbeza dan ultra-kapasitor (UC) digabungkan ke dalam dua-kawasan Penyusunan Semula Sistem Kuasa untuk mengukuhkan daya dan frekuensi garis-sempadan. Seterusnya, teknik pengoptimuman baru seperti pencarian cuckoo (CS), algoritma kelelawar (BA), pengoptimuman penyengat-api (MFO) digunakan dalam kerja ini untuk menilai keupayaan pengawal 2DOF yang dicadangkan dan prestasinya diperbandingkan dalam semua kontrak Penyusunan Semula Sistem Kuasa. Hasil simulasi, penggabungan DPFC, UC dan 2DOF PID-FOPDN berasaskan MFO menunjukkan kadar turun naik yang rendah dalam frekuensi dan daya garis-sempadan. Selain itu, masa penyelesaian (ST) dua kawasan adalah 9.5 saat untuk $\Delta F1$, 8.2 saat untuk $\Delta F2$, dan 10.15 saat untuk $\Delta Ptie$. Kekukuhan pengawal yang disarankan telah disahkan oleh ± 25% variasi dalam parameter sistem dan keadaan pemuatan.

ABSTRACT

Modern restructured power system faces excessive frequency aberrations due to the intermittent renewable generations and persistently changing load demands. An efficient and robust control strategy is obligatory to minimise deviations in the system frequency and tie-line to avoid any possible blackout. Hence, in this research, to achieve this target, automatic generation control (AGC) is utilized as a secondary controller to alleviate the changes in interconnected restructured systems at uncertainties. The objective of AGC is to quickly stabilize the deviations in frequency and tie-line power following load fluctuations. This thesis addresses the performance of AGC in two-area restructured power systems with many sophisticated control strategies in the presence of renewable and traditional power plants. As per literature of research work, there are quite a few research studies on AGC of a restructured system using optimized coordinative controllers. Besides, investigations on advanced optimized-based coordinative controller approaches are also rare to find in the literature. So, various combinations of two degrees of freedom (2DOF) controllers are utilized as supplementary controllers to diminish the frequency deviations. Nevertheless, the interconnected tie-lines are typically congested in areas with huge penetration of renewable sources, which may reduce the tie-line capability. Therefore, distinct FACTS controllers and ultra-capacitor (UC) are integrated into two-area restructured systems for strengthening the tie-line power and frequency. Further, new optimization techniques such as cuckoo search (CS), bat algorithm (BA), moth-flame optimization (MFO) are utilized in this work for investigating the suggested 2DOF controllers and compared their performance in all contracts of restructured systems. As per the simulation outcomes, the amalgamation of DPFC and UC with MFO-based 2DOF PID-FOPDN shows low fluctuation rate in frequency and tie-line power. Besides, the settling times (ST) of two areas are 9.5 S for ΔF_1, 8.2 S for ΔF_2, and 10.15 S for $\Delta P_{tie.}$ The robustness of the suggested controller has been verified by ±25% variations in system parameters and loading conditions.

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