UNIVERSITI PUTRA MALAYSIA

MULTI-OBJECTIVE SERVICE RESTORATION IN DISTRIBUTION NETWORKS USING GENETIC ALGORITHM

EHSAN MOAZAMI

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MULTI-OBJECTIVE SERVICE RESTORATION IN DISTRIBUTION NETWORKS USING GENETIC ALGORITHM

By

EHSAN MOAZAMI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

MULTIOBJECTIVE SERVICE RESTORATION IN DISTRIBUTION NETWORKS USING GENETIC ALGORITHM

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April 2013

Chairman : Professor Mohd. Zainal Abidin Ab Kadir, PhD PEng

Faculty : Engineering

Electricity is the backbone of each industrialised society and economy. Modern countries are not used to having even short power blackouts. As an effective post-fault supply restoration strategy for distribution networks plays a key part in improving service reliability and enhancing customer satisfaction, where there has been considerable research effort focused on this problem. The main challenge has been in reducing the search space so as to achieve an optimal solution within an acceptable computing burden. Furthermore, restoration is a multi-objective problem that used for solving the minimization of out of service area, minimization of switching operation and minimization of power loss whilst considering the technical constraints. This thesis presents a new approach of supply restoration service using the Genetic Algorithm. The GA is robust in searching a global optimal solution for the large-scale combinatorial optimization problems. A new hybrid Genetic

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Algorithm is proposed for reducing the search space and execution burden in solving the supply restoration problems.

A proposed algorithm is investigated for radiality checking that is found very efficient in distribution restoration problems. Another proposed technique is implemented to improve the penalty strategy to enhance the performance of algorithm and reduce the convergence iteration. The effectiveness of the proposed method is demonstrated by testing on two case studies, a 33-bus test system and a 16 bus test system. Then the results are compared with the previous works all using GA in restoration. Comparisons show the improvements in reducing of number of iteration and fulfilling the radiality of the system after restoration. Findings through comparisons are shown that the proposed method will be able to do full restoration and energize all loads. Also, full reenergizing of all loads as the most important objective function is satisfied with less number of switching and better voltage profile. According to the comparison of the result of thesis with other previous work, it can be observed that reducing the number of iteration is significantly reduced. Results shows very low iteration number and low computation burden compare to other previous works.

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Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

PEMULIHAN PERKHIDMATAN OBJEKTIF-PELBAGAI DI DALAM RANGKAIAN PENGAGIHAN MENGGUNAKAN ALGORITMA GENETIK

Oleh

EHSAN MOAZAMI

April 2013

Pengerusi : Profesor Mohd. Zainal Abidin Ab Kadir, PhD PEng

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Elektrik merupakan tunjang utama kepada setiap industri dan ekonomi. Negara-negara maju akan memastikan tiada gangguan bekalan kuasa walaupun dalam jangkamasa pendek. Sebagai strategi pemulihan bekalan yang berkesan untuk sistem pengagihan selepas gangguan bekalan, ianya memainkan peranan yang penting dalam meningkatkan kebolehpercayaan perkhidmatan dan meningkatkan tahap kepuasan pelanggan, di mana terdapat usaha penyelidikan yang memberangsangkan ke arah permasalahan tersebut. Cabaran utama adalah dalam mengurangkan ruang carian bagi mencapainya satu penyelesaian yang optimum dalam beban pengkomputeran yang boleh diterima. Tambahan pula, pemulihan adalah masalah multi-objektif yang digunakan untuk menyelesaikan pengurangan kehilangan kuasa disamping mempertimbangkan kekangan teknikal. Tesis ini membentangkan satu pendekatan baru perkhidmatan pemulihan bekalan menggunakan algoritma genetik

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(GA). GA ini cekap dalam mencari penyelesaian global yang optimum bagi masalah kombinasi optimum yang berskala besar.

Sebuah algoritma genetik hibrid yang baru telah dicadangkan untuk mengurangkan ruang carian dan beban pelaksanaan dalam menyelesaikan masalah pemulihan bekalan. Algoritma yang dicadangkan ini disiasat untuk semakan radialiti yang dilihat sangat berkesan dalam pemulihan masalah. Teknik yang dicadangkan telah dilaksanakan untuk meningkatkan strategi penalti untuk memangkin prestasi algoritma dan mengurangkan pengulangan pemusatan. Keberkesanan kaedah yang dicadangkan ini ditunjukkan dengan ujian yang dijalankan terhadap dua kajian kes iaitu sistem ujian 33-bus dan sistem ujian 16-bus. Seterusnya, keputusan yang diperolehi dibandingkan dengan kerja-kerja sebelum ini yang menggunakan GA dalam pemulihan. Perbandingan menunjukkan peningkatan dalam pengurangan bilangan pengulangan dan memenuhi radialiti sistem selepas pemulihan. Keputusan melalui perbandingan menunjukkan bahawa kaedah yang dicadangkan dapat melakukan pemulihan penuh dan penyaluran tenaga kepada semua beban. Di samping itu, pemulihan semula tenaga penuh pada semua beban merupakan objektif terpenting yang memuaskan dengan pengurangan bilangan pertukaran dan profil voltan yang lebih baik.

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I certify that a Thesis Examination Committee has met on 4/9/2013 to conduct the final examination of Ehsan Moazami on his thesis entitled **"Multiobjective Service Restoration in Distribution Networks Using Genetic Algorithm"** in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A)] 15 March 1998. The committee recommends that the student be awarded Master of Science.

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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently submitted for any other degree at Universiti Putra Malaysia or at any other institutions.

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EHSAN MOAZAMI

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