شبكة المعلومات الجامعية

بسم الله الرحمن الرحيم

HOSSAM MAGHRABY

شبكة المعلومات الجامعية

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

HOSSAM MAGHRABY

شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها

علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار

HOSSAM MAGHRABY

Ain Shams University, Faculty of Engineering,
Electrical Power and Machines Department

DISTRIBUTION SYSTEMS RESTORATION USING OPTIMIZATION TECHNIQUES

By
Hossam El-Din Mohsen Abd El-Aziz El-Dakroury

B.Sc. Electrical Engineering, Ain Shams University, 2012

A Thesis Submitted in Partial Fulfilment of the Requirement for the Degree of Master of Science in Electrical Engineering

Supervised by

Prof. Dr. / Almoataz Youssef Abdelaziz

Electrical Power and Machines Dept.
Faculty of Engineering,
Ain Shams University

Dr. / Ahmed Hossam Gad

Electrical Power and Machines Dept.
Faculty of Engineering,
Ain Shams University

Faculty of Engineering, Ain Shams University
Cairo, 2021

To my guardian angel, my mother Hala El-Rabei

Acknowledgement

This work has been possible thanks to my supervisors, Prof. Dr. Almoataz Y. Abdelaziz, whose guidance, support, scientific knowledge, humanitarian and morals were the main key for getting through all challenges and obstacles whether technical or personal, and made this work done. And to Dr. Ahmed Hossam Gad, who helped me with his valuable scientific and practical knowledge; the knowledge, technical and personal skills, i gained under his supervision, were priceless. I am very grateful for all what my supervisors have done to me through this journey which was full of inspiration, support and cheer because of them.

Thanks to Hala, my mother, my rock, my angel and the reason to live. Who had devoted her entire life to me and my brother, sacrificing her happiness for ours. Even through all her difficulties she faced bravely during my master's, she kept supporting and encouraging me to keep up with my master's nevertheless, although all her suffer in those hard moments. I owe her every single happy moment in my life.

Thanks to Mohab, my brother who has always been my best friend, for emotion and practical support and being always there for me no matter what.

Thanks to my cardiologist Prof. Dr. Maiy Hamdy El Sayed who saved my life by performing a heart operation after I was being diagnosed with a rare heart disease during my masters. she stepped up when many other doctors were afraid to perform the operation due to its the criticality. She is an excellent doctor and excellent human being.

Thanks to my boss Eng. Ahmed Ibrahim who without his support and help during my masters and my heart operation, I would not make it. His kindness, caring and support had enormously helped me.

Thanks to all my friends, colleagues and family members who had mentally and emotionally supported me and I wish I make you all proud of me.

Statement of Original Authorship

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

Signature: _____

Date: _____

EXAMINERS' COMMITTEE

This thesis entitled "DISTRIBUTION SYSTEMS RESTORATION USING OPTIMIZATION TECHNIQUES" by Hossam El-Din Mohsen El-Dakroury meets the requirements for the award of Master of Science (M.Sc.) Degree in Electrical Engineering Ain Shams University, Faculty of Engineering, and it is approved for its contribution to knowledge and literary presentation.

Name, Title and Affiliation — Signature

1. Prof. Dr. Ahmed Mohamed Ibrahim
   Electrical Power Engineering Dept.
   Faculty of Engineering
   Cairo University

2. Prof. Dr. Said Fouad Mekhamer
   Electrical Power and Machines Dept.
   Faculty of Engineering
   Ain Shams University

3. Prof. Dr. Almoataz Youssef Abdelaziz
   Electrical Power and Machines Dept.
   Faculty of Engineering
   Ain Shams University

Abstract

Among the various components installed in the electrical distribution systems, main and lateral feeders are the most susceptible to temporary and permanent faults. Line faults are generally inevitable because they occur due to severe weather conditions and/or other natural events. The disconnection of customers from the utility grid affects the reliability indices of the distribution system and might cause several economic and technical problems. Due to such a problem, load restoration process takes place in order to restore the maximum number of disconnected loads due to line faults. Disconnected loads are restored by altering the statuses of sectionalizing (normally closed) and open-tie (normally open) switches. Load restoration operation is formulated as a mixed-integer nonlinear programming problem that aims at reaching a configuration which restores the maximum number of disconnected loads without violating topological or operational constraints.

Thesis consists of seven chapters. First chapter is an introduction of thesis topic. Second chapter discusses the importance of the electrical distribution system and its various components, focusing on the main component in thesis (the transmission lines) which are the most vulnerable to interruptions and the effect of these faults on the performance and reliability of electric system with a set of examples of faults that occurred in history in existing distribution systems and their impact on electrical systems, then the term "Restoration" is explained and how to apply it on electric system and the different types of functions that can be used to restore lost loads and methods of solution in cases of multi-functions. Also the different methods of optimizations methods used in restoration are explained, along with the advantages and disadvantages of each method, mentioning its application in various researches, along with presenting a survey of researches, systems, functions, and optimization methods used in literature. In chapter three, the electrical distribution system, its components, types, and the advantages and disadvantages of each type are explained, in addition to converting the electrical system to a set of mathematical equations expressing the system and its components, including the function to be optimized and the variables state to be found under different system constraints, with an explanation of the method of power flow in the electrical system and how to apply it in order to check system constraints. Chapter four, discusses the metahuristic method used in thesis, binary particle swarm optimization, it’s equations, and how to apply them to the electrical system in order to restore lost loads, in addition to the term “load shedding”, and how to use it into the function to be optimized, and how the programming deals with it as a method of solution in critical faults cases in order to achieve partial restoration. In chapter five, the proposed method is programmed, implemented and tested on a 118-bus distribution system by applying a variety of fault cases on feeder lines. Simulation results have also been compared with those published in previous research. In Chapter Six, load restoration by mathematical methods, including the required function, constraints, and approximation, illustrated theoretically. In chapter seven , Conclusions of Thesis are presented, as well as proposals for future work in this area.

Keywords

Load Restoration, Network Reconfiguration, Self-Healing, Radial Distribution System, Particle Swarm Optimization, BPSO, MINLP, MILP, Smart Grids, Neural Networks.

Table of Contents

List of Tables

List of Figures

.