UNIT COMMITMENT SCHEDULING USING PARTICLE SWARM OPTIMIZATION

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DEDICATION

To my father, Alhaji Dodo Yusuf and my late mother, Mallama Fatimatu Alhaji Dodo (may Aljanat Firdaus be her final abode) for their sacrifices in ensuring I attain the best in life.

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ABSTRACT

An important criterion in power system operation is to meet the power demand at minimum fuel cost using an optimal mix of different power plants. Moreover, in order to supply electric power to customers in a secured and economic manner, thermal unit commitment is considered to be one of the best available options. It is thus recognized that the optimal unit commitment of thermal systems results in a great saving for electric utilities. Unit Commitment is the problem of determining the schedule of generating units subject to device and operating constraints. The formulation of unit commitment has been discussed and an algorithm based on Particle Swarm Optimization technique, which is a population based global search, has been developed to solve the unit commitment problem. The algorithms which was written in MATLAB codes was implemented on IEEE six bus system. The results showed that PSO is effective in producing optimal solution for UC problem with minimised operating cost within 45 minute execution time.

ABSTRAK

Kriteria penting dalam operasi sistem kuasa adalah untuk memenuhi permintaan tenaga pada kos bahan api minimum menggunakan gabungan loji kuasa yang berbeza. Lebih-lebih lagi, untuk membekalkan kuasa elektrik kepada pelanggan dalam cara yang selamat dan ekonomi, komitmen unit termal dianggap sebagai salah satu pilihan terbaik. Oleh itu, diiktiraf bahawa komitmen unit optimum bagi sistem terma menghasilkan penjimatan yang besar untuk utiliti elektrik. Komitmen Unit adalah masalah menentukan jadual unit penjanaan tertakluk kepada peranti dan kekangan operasi. Perumusan komitmen unit telah dibincangkan dan algoritma berdasarkan teknik Pengoptimuman Swarm Partikel, yang merupakan pencarian global berasaskan populasi, telah dibangunkan untuk menyelesaikan masalah komitmen unit. Algoritma yang ditulis dalam kod MATLAB telah dilaksanakan pada sistem bas enam IEEE. Hasilnya menunjukkan bahawa PSO berkesan dalam menghasilkan penyelesaian yang optimum untuk masalah UC dengan kos operasi yang diminimumkan dalam masa pelaksanaan 45 minit.

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LIST OF ABBREVIATIONS

IEEE	-	Institute of Electrical and Electronics Engineers
UC	-	Unit Commitment
ELD	-	Economic Load Dispatch
ACO	-	Ant Colony Optimisation
BCO	-	Bee Colony Optimisation
GA	-	Generic Algorithm
MILP	-	Mixed Integer Linear Programming
PSO	-	Particle Swarm Optimisation
LR	-	Lagragian Relaxation

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CHAPTER 1

INTRODUCTION

1.1 Introduction

In modern time, power systems across the globe had grown in complexity of interconnection and power demand. The emphases are now more on satisfactory performance, increased customer focus, cost affordability, reliability, cleanliness and system security. This development has informed shortage of energy resources, increasing cost of generation and environmental disorderliness placing the need to balance the demand and supply of electricity on the front burner at an affordable rate. The demand for electricity assumes weekly and seasonal patterns therefore various power units are to be strategically scheduled to meet this unstable demands at lowest generation cost [1,2].

The essence of electric power utilities is to supply power with high-quality, reliability and security to the consumers at the lowest possible cost while operating to meeting the limits and constraints imposed on the generating units. This formulates the unit commitment (UC) problem for finding the optimal combination, on/off scheduling status and generation output of units within a short- term planning interval (i.e. for a day). It is aimed at reducing the cost incurred for power production whilst meeting overall system power balance and spinning reserve constraints together with individual unit constraints concurrently. Nowadays, UC plays important roles in the everyday planning of power systems around the world, a proper UC scheduling can reasonably lower the cost incurred on the generated power, millions or even billions of money can be saved per year [7].

UC is one of the basic problems in power generation that has subjected system engineer to a big challenge. It is essentially, a nonlinear, mixed integer combinatorial optimization task for meeting the load demand by appropriate scheduling of units for over a specified period of time. The period of time can stretch from a few hours to a week. UC determines when and which unit should run and amount of power to be dispatched for the purpose of optimizing the generation cost [4,7].

The UC problem is a future scheduling decision accomplished in two ways. Firstly, it is concerned with the determination of the on/off status of the units and the other aspect deals with the amount of power dispatched by each unit committed subject to the load demand [5].

Chapter one presents overview of the chapter then follows problem statements, research objectives, significance of the research, research scope and thesis outline.

1.2 Problem Statement

Various studies had been undertaken on UC problem with several optimization techniques. Some of the setbacks noticed in the techniques reviewed lead to the formulation of the following problem statement:

(a) A method based on Mixed Integer Linear Programming approach was used in coordinating and scheduling short-term maintenance with hourly security constrained UC. The operational cost was minimised but it was time consuming and involved rigorous computation.

(b) The Priority List (PL) approach when used in solving UC is usually affected by highly heuristic characteristics and generally substandard solutions because the minimum up/down time limits in committing units when meeting up with the spinning reserve limit were ignored.

(c) The Dynamic Programming applied in solving UC Problem was characterised by a huge computational time requirement.

(d) The Improved Particle Swarm Algorithm employed in UC did not consider minimum start-up/shutdown time and unit ramp rate.

Hence, this work was carried out to validate UC scheduling using PSO.

1.3 Project Objectives

This project is aimed as UC scheduling using PSO. It has the following stated objectives:

(a) To develop algorithm for unit commitment problem based on PSO approach in MATLAB Software

(b) To Analyze the generation schedule and total operating cost based on PSO approach

(c) To compare the results obtained before and after solving Unit Commitment using PSO

1.4 Significance of the Project Work

This project work has provided another credible alternative approach to solving UC problem. The generation schedule that resulted from the use of PSO could reduce the overall operating cost, save enormous storage memory and reduce execution time.

The discoveries from this work will immensely benefit electricity companies in planning generation and will also improve their profit profiles.

1.5 Project Scope

Particle Swarm Optimization algorithms was written in MATLAB SIMULINK code and tested on IEEE Six Bus System to validate the solution for Unit Commitment problem.

Figure 1.1 shows the overall scope of the project work for UC scheduling by PSO approach.

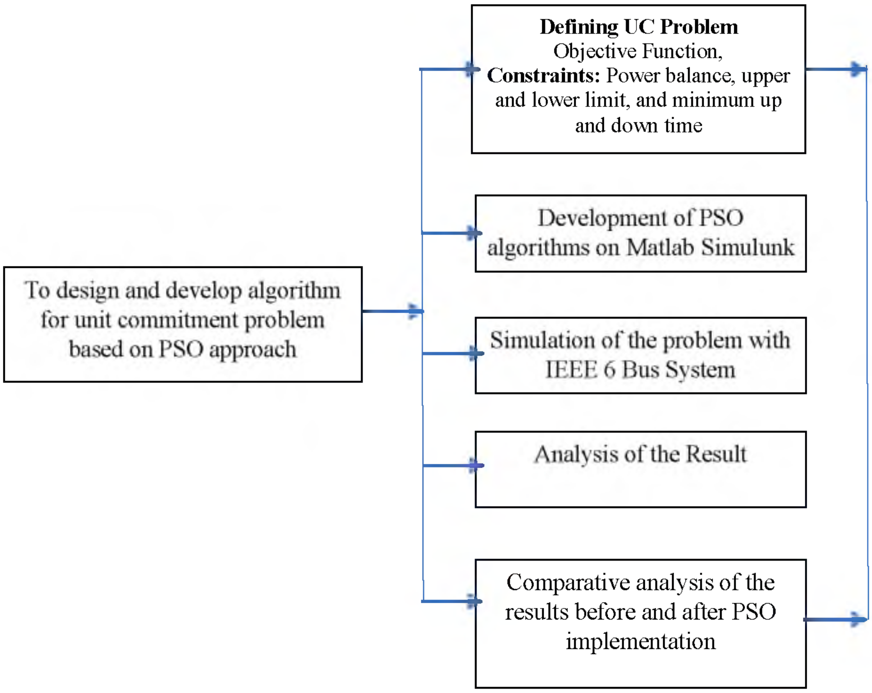

Figure 1.1 Scope of Research

1.6 Thesis Organisation

This thesis comprises five chapters, namely, the introduction, literature review, research methodology, results and discussion, conclusion and future recommendation.

Chapter 1 presents the introduction of the research, background, problem statement, objectives, and the scope of the study.

Chapter 2 discusses the literature review on UC, ELD, correlation between UC and ELD and PSO Algorithm. Previous works done by other researchers is a motivation to propose another method (PSO) in solving UC problem. Several solutions and techniques are analysed based on the literature. The techniques from the previous research that is related to this research are also discussed and summarised in this chapter.

Chapter 3 explains the methodology applied in this research. This chapter consists of a flow chart, design specification, simulation process.

Chapter 4 explains design calculation, result, discussion and analysis

Chapter 5 explains summary of findings and conclusion along with future research recommendation.

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