M.Sc. Thesis

Optimizing the non cascaded short term hydrothermal scheduling using accelerated particle swarm optimization (APSO) algorithm

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DECLARATION

I, Hafiz Zaheer Hussain, solemnly declare that the work presented in this thesis is my own and nothing is reproduced to make contempt of plagiarism.

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DEDICATION

I dedicate this research work to the Beloved Holy Prophet Muhammad (PBUH), members of his holy family and his highly loyal companions (may Almighty Allah be pleased with all of them) because He (PBUH) is the one who opened all the doors of knowledge benevolence.

ACKNOLEDGEMENT

I like to acknowledge first to ALLAH Almighty, the most merciful and beneficial, the Lord of all and His Beloved Holy Prophet (PBUH) as a gesture of thanks for without their will: it could never be possible.

I also thankful to my parents and my siblings for providing me moral and financial support throughout my education and assisted me whenever I felt down.

I would like to express my sincere appreciation to my MSEE thesis advisor, Associate Prof. Dr. Aun Haider for his invaluable support, guidance, and unwavering encouragement during my MS Electrical Engineering thesis activity. His extensive vision and creative thinking have been the source of inspiration for me throughout this work and also transforming my mental ideas into a concrete research work in the form of this thesis. His personality and management experience are examples for me.

I am quite grateful to my committee members Dr. Khawar Siddique Khokhar (CoD-EE),Dr. Sajjad Hussain Shami, Dr. Aun Haider, Dr. Muhammad Adnan, Dr. Muhammad Farhat Kaleem, and Dr. Irfan Ullah, Muhammadfor their valuable suggestions and numerous help. Moreover, I am also like to thanks Dr. Ali Ahmad, and Jameel Ahmad for teaching me the courses Research Methodology and Photo Voltaic Energy System which sufficiently helped me during my research work.

I am also cordially like to thanks Dr. Ejaz Ahmad Chaudhry (Dean SEN), Lt Col Khan Muhammad Nazir, Muhammad Salman Fakhar, Muhammad Asim Butt, Muhammad Ilyas Khan and especially Dr. Hasan Sohaib Murad Rector UMT Lahore who giving me such opportunity in form of (full scholarship in MSEE), without this may be it seems to be very difficult. Such policies will be very helpful for those students who have passion to continue their study and serve their nation. It may leave a very small financial impact on the university but a huge being a student.

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ABBREVATIONS AND NOTAIONS

STHTS	:	Short Term Hydrothermal Scheduling
PSO	:	Particle Swarm Optimization
FIPSO	:	Fully Informed Particle Swarm Optimization
APSO	:	Accelerated Particle Swarm Optimization
FEP	:	Fast Evolutionary Programming
GA	:	Genetic Algorithm
HEP	:	Hybrid Evolutionary Programming
CEP	:	Classical Evolutionary Programming
GAF	:	Genetic Algorithm Framework
SA	:	Simulated Annealing
V	:	Volume of Water in the Reservoir (acre-ft)
E	:	Steam Energy (Joule)
F	:	Fuel Cost ($)
J	:	Iteration
N	:	Number of Scheduling hours
Q	:	Discharge rate (acre-ft/hr.)
$P_{thermal}$	:	Thermal Power (MW)

P_{Losses}	:	Hydel Power Losses (MW)
P_{hydel}	:	Hydel Power (MW)
P_{load}	:	Load Demand (MW)
$P_{g\_best}^{j}$	:	Global best particle at j^{th} iteration
$P_{c\,best}^{j}$	:	Current best particle at j^{th} iteration
x_i^j	:	Present position of the i^{th} particle at j^{th} iteration
x_i^{j+1}	:	Next position of the i^{th} particle at j^{th} iteration
ε	:	Uniform random vector
k	:	Constraint coefficient
$P_{nbr(n)}^{j}$	:	Neighbor of particle x_i^j at j^{th} iteration
α & β	:	Learning parameters or acceleration constants
α_0	:	Initial value of the randomness parameters
γ	:	Control parameter
$\theta(j)$	:	Inertia function
w	:	Weight parameter

ABSTRACT

Efficient planning and optimal economic operation of power generation systems have played a major role in the growth of electrical power industry. Future energy demand not only depends upon increase of power generation units, but also requires the optimal operation of existing power systems. The cost of hydroelectric power generation is minimum but is not enough to fulfill the consumer's electric power demand. Hence hydroelectric power system is used in conjunction with the thermal power system. A hybrid of both these electrical generation processes increase the overall power generation cost. In this thesis a meta-heuristic Accelerated Particle Swarm Optimization (APSO) algorithm has been proposed for hydro-thermal scheduling problem. The performance of the APSO algorithm has better than the existing various optimization techniques such as Lagrange Multiplier, Gradient Search, Simulated Annealing, Genetic Algorithm, Evolutionary Programming and its variants, Canonical Particle Swarm Optimization and its variants. It takes extremely less execution time and minimum number of iterations required to reduce the overall production cost of short term hydrothermal scheduling problem while meeting all constraints with and without considering transmission losses.

1.1 Introduction

Electrical energy has become an important need in the world. Future energy demand not only depends upon increase in power generation but also requires economic dispatch of the installed power generation system. Hydroelectric power is one of the economic sources of power in comparison with thermal power generation. The cost of hydroelectric power generation is minimum compared to other power generation mechanisms. However discharge rate is a major factor due to water usage for irrigation purposes, the hydroelectric power generation is not enough to fulfill the consumer's electric power demand. Hence hydroelectric power system is used in conjunction with thermal power system. A hybrid of these two electrical generation process increases the overall cost of electricity production. However hydro-thermal scheduling is a complicated problem. The main purpose is to reduce the production cost of the generators and to enhance the overall efficiency of the system.