UNIVERSITI TEKNOLOGI MARA

CHAOTIC MUTATION IMMUNE EVOLUTIONARY PROGRAMMING FOR PHOTOVOLTAIC PLANNING IN POWER SYSTEM

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

The demand for power system is escalating tremendously due to the existence of new industrial areas with massive population growth. This situation creates significant challenges for utility companies to explore the renewable energy resources such as the solar photovoltaic (PV). However, several issues arise when dealing with the PV installation into the power system such as the power losses, voltage stability and economic impact. Therefore, the installation of PV requires optimization process to identify the correct location and sizing. This thesis presents a new novel Chaotic Mutation Immune Evolutionary Programming (CMIEP) for optimal location and sizing of distributed generation photovoltaic (DGPV) installations in transmission system. Both single and multi-objective problems were considered in this study. In this study, the first research objective is to formulate a hybrid metaheuristic technique, namely, CMIEP for load management in power system. CMIEP integrates the elements of cloning and mutation from the original Artificial Immune System (AIS) and Evolutionary Programming (EP), respectively. The simulation was done to determine the maximum loadability of load buses for three different test system networks while taking into account the maximization of voltage stability index called Fast Voltage Stability Index (*FVSI*). The breadth and depth of the study are expanded to the next contribution. The second objective is to determine the location and sizing of multi-unit DGPV for single-objective problem using CMIEP. The element of chaotic local search is also integrated into the algorithm for better performance. A new optimisation engine was developed to address this issue. Consequently, the third objective is to develop a new optimization technique termed as Multi-Objective Chaotic Immune Evolutionary Programming (MOCMIEP) for optimal location and sizing of DGPV installations in multi-objective problem to minimize the *FVSI* value and transmission loss. Finally, the proposed CMIEP was used as the algorithm for DGPV location and sizing with the existence of line outage contingency and generator outage contingency. New automatic contingency analysis and ranking algorithm due to line and generator outages were separately developed considering the *FVSI* value. Further research was done on the cluster formation of DGPV installation from the obtained results. The results obtained from this study could be utilized by utility companies for planning the installation of DGPV into the grid system for minimization of transmission loss and *FVSI* value in their systems. The contributions of research are as follows: a) formulation of new optimization technique termed as CMIEP, b) development of new optimization engine for solving the multi-DGPV installation scheme, c) development of multi-DGPV installation scheme and d) development of a new technique clustering process under line-outage or generator-outage contingency. The knowledge contributions from this study would be beneficial to power system operators and planners for future offline development and expansion of their system

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May these humble discoveries of mine contribute to the scientific community!

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