UNIVERSITI TEKNOLOGI MARA

INTEGRATED IMMUNE-COMMENSAL-EVOLUTIONARY PROGRAMMING FOR ECONOMIC DISPATCH AND DISTRIBUTED GENERATION INSTALLATION

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PhD

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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 result 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.

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ABSTRACT

Electrical power industry has experienced many changes over the past thirty years. The process of solving Economic Dispatch (ED) would not be the same again with the penetration of renewable energy sources or also known as Distributed Generation (DG) as they can be anywhere in power system. Several optimization techniques are found to be computationally burdensome, which led to being trapped at local optima. Additionally, most concurrent ED and DG installation schemes left out total system loss while minimizing total production cost, which will lead to the waste of energy in power system. The situation becomes worse with the presence less flexibility in the single objective optimization process of ED due to only one objective can be optimized at a time. Therefore, this study proposes a new hybrid technique termed as Immune-Commensal-Evolutionary Programming (ICEP) to solve ED problems of power system. ICEP is developed from the hybridization of three independent optimization techniques, namely Symbiotic Organisms Search (SOS), Artificial Immune System (AIS) and Evolutionary Programming (EP). EP is the leading optimizer of the hybrid algorithm while cloning operator of AIS and commensal operator of SOS are adopted into the EP algorithm to improve its performance. Convex and nonconvex ED problems have been solved using ICEP with two objective functions (total production cost minimization and total system loss minimization). Subsequently, an integrated technique termed as integrated ICEP based ED and DG installation (ICEP-ED-DG) has been formulated to minimize the total production cost and total system loss independently. A multi-objective optimization algorithm was subsequently proposed to minimize the total production cost and total system loss in a combined problem formulation via the integrated Economic Dispatch and Distributed Generation installation (ED-DG). The proposed multi-objective technique is termed as the Multi-Objective Immune-Commensal-Evolutionary Programming (MOICEP). MOICEP has been used to solve the integrated Economic Dispatch and Distributed Generation installation (ED-DG) problems. All the proposed techniques have been implemented on the IEEE 30-Bus and 57-Bus Reliability Test Systems. Results produced by ICEP indicated that ICEP performed much better than the traditional EP and AIS in solving the convex and nonconvex ED. It is also discovered that the proposed integrated ICEP-ED-DG technique outperformed the integrated EP-ED-DG and integrated AIS-ED-DG techniques in minimizing the total production cost and total system loss. Consequently, the performance of the proposed MOICEP algorithm is outstanding when compared with MOEP and MOAIS in solving the integrated ED-DG problems under several scenarios. The proposed ICEP, integrated ICEP-ED-DG and MOICEP have demonstrated outstanding performance in this study; making it feasible for solving related ED and DG installation problems in larger and bulk power systems under minor variations in their original algorithms.

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