UNIVERSITI TEKNOLOGI MARA

IMMUNIZED-BRAINSTORM-EVOLUTIONARY PROGRAMMING TECHNIQUE FOR DG INSTALLATION AND POWER SCHEDULING WITH ECONOMIC IMPACT IN TRANSMISSION SYSTEM

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ABSTRACT

The increasing demand for electricity, increasing concerns about environmental care and fear of fossil fuel resources' depletion encourage the installation of distributed generation (DG), especially renewable energy-based DG (RE-DG), into the traditional power system globally. The once horizontal power system network transforms into a vertical structure gradually via new energy policies in key-player countries. This move has further promoted the growth of RE-DG. However, large-scale DG penetration into the existing power system poses a threat to the overall performance and security of the network. This is due to the intermittent nature of the RE-DG as well as the change in the system power flow. Thus, installation of DG requires proper planning in terms of optimal DG sizing and siting as well as enhanced energy management among the energy sources in the system. This thesis proposes Immunized-Brainstorm-Evolutionary Programming (IBSEP) technique for DG installation and power scheduling with economic impact in transmission systems. The optimal DG locations and sizing are calculated for system loss reduction, minimum voltage enhancement, or DG cost minimization. Subsequently, it also integrates the DG installation and power scheduling as a part of the transmission planning. All four DG types are considered for installation in this study, especially in the early decision process. The impact of each DG type installation on the system performance for all objective functions is compared. Impracticality of considering single objective for DG allocation decision deems for multi-objective optimization solution. Decision on the proper weights for each fitness function that forms the multi-objective function is challenging and requires insights from highly experienced power system planners and operators. Hence, this study also proposes an adaptive weightage-based multi-objective optimization technique to assist power system planners and key players in the power industry in their decision-making process. As large-scale DG penetration alters the power flow of a power system, proper energy management between both centralized and decentralized energy power sources is needed to ensure improved system performance. Therefore, optimal active power scheduling is integrated with DG installation consideration. All the developed techniques have been compared with their base techniques as the benchmarked techniques, which are Artificial Immune System (AIS), Brain Storm Optimization (BSO) and Evolutionary Programming (EP). The simulations for all techniques have been verified using two IEEE reliability test systems (RTS), IEEE 30-Bus RTS and IEEE 118-Bus RTS, that were put under stressed conditions. Rigorous simulations stipulate the superiority of the developed hybrid IBSEP technique over other benchmarked techniques in terms of the higher accuracy of the solutions provided. The results indicate that the installation of DG with real power delivery performs better in system loss minimization than DG without a real power component. DG installation in transmission power systems is proven to be able to improve the efficiency and reliability of the system even when the system is put under stressed conditions and contingency conditions. The proposed technique has the potential for further future exploration studies in solving either power system or general optimization problems with considerable alteration. The findings from this study could also benefit power system utilities in their future power system transmission planning.

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