

Optimal design of power system stabilizer for multimachine power system using farmland fertility algorithm

ABSTRACT

Optimal design of interconnected multimachine power system with power system stabilizers (PSSs) enduring critical conditions is a challenging assignment due to several nonlinear dynamic device and components associated to the system. In this research, the effective application and performance assessment of genetic algorithm (GA), particle swarm optimization (PSO) and a new metaheuristic-based farmland fertility algorithm (FFA) search algorithm for designing of coordinated multi PSSs in an interconnected multimachine power systems are presented and the limitations of the existing techniques (GA and PSO) are disclosed. The PSSs design problem is transformed into an optimization problem which an eigenvalue-based objective function is developed and both the GA, PSO and the proposed FFA optimization methods are applied to search for the optimal control parameters of the PSSs that are connected to the multimachine in the power system. The PSSs are tested on an interconnected two-area ten-machine system of 39-bus New England IEEE test power system under multiple operating conditions. The optimization methods performance in terms of convergence characteristics, search computational cost, and the search quality solution are compared for justification. The eigenvalue and phasor simulation analysis results are compared so as to validate the efficiency of both optimization methods for the PSSs design thus, to control low frequency oscillations (LFOs) which improves the system dynamic stability. Also, the phasor simulation results exhibits that the transient responses of the system rise time, settling time, peak time and peak magnitude were all impressively improved by an acceptable amount for the test system with the proposed FFA-PSS. Moreover, at the end of the analysis, the FFA based PSSs design was found to converge faster with low computational cost and produces enhanced optimal PSSs parameters as compared to the other existing algorithms. Thus, the application and performance of the FFA has appeared as a promising method and can be considered as a remarkable method for optimal design of multi PSSs in a large interconnected power systems.

Keyword: Power system stabilizer (PSS); Farmland fertility algorithm (FFA); Particle swarm optimization(PSO); Genetic algorithm (GA); Low frequency oscillations (LFO); Dynamic stability and multimachine power system