Farmland fertility optimization for designing of interconnected multi-machine power system stabilizer

ABSTRACT

This study describes the process of interconnected multi-machine power system stabilizer (PSS) optimization using a new intelligent technique called farmland fertility algorithm (FFA) to increase the stability of IEEE three machine nine bus power system and offset the low-frequency oscillations (LFOs) during a symmetrical 100 ms three-phase fault at bus 9. The FFA-PSS controller performance is compared with two familiar classical techniques, i.e. Genetic Algorithm (GA-PSS) and Particle Swarm Optimization (PSO-PSS) to confirm the capability of the proposed technique to realize improved system stability enhancement. The Eigenvalue simulation results with FFA produce stable Eigenvalues that increase the damping ratio of the Electromechanical Modes (EMs) to more than 0.1 with smaller overshoots and time to settle which shows the effectiveness of the method for multi-machine stability improvement. Also, the phasor simulation results show 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 interconnected system with the proposed FFA-PSS thus, was able to control the LFOs effectively and produces enhanced performance compared to the GA and PSO based PSS. Similarly, the result validates the effectiveness of the proposed FFA tuned PSS for LFO control which demonstrates robustness, efficiency, and convergence speed ability than the classical GA and PSO tuning methods.

Keyword: Farmland fertility algorithm; Genetic algorithm; Low-frequency oscillation; Particle swarm optimization; Power system stabilizer