Optimizing Power Controller Performance using Genetic Algorithm: A Step-by-Step Approach for Finding Optimal Values and Improving Control Performance

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Abstract

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Abstract:

The transient parameters of a power system stabilizer can be optimized to improve system stability using a genetic algorithm. This algorithm is used to fine-tune the parameters of the stabilizer by searching for the optimal values that minimize oscillations and improve stability. The genetic algorithm is a meta-heuristic optimization method that can be used to design the supplementary damping controller within the stabilizer. By using this algorithm, the control gain of the damping controller can be minimized to reduce oscillation damping, and the critical modes can be moved to improve stability. The genetic algorithm is also used to find the optimal values of control variables such as terminal voltage exciter, angular speed, and active power, to enhance voltage stability in the power system. The research proposed a methodology for obtaining optimal values for power system stabilizer variables using the genetic algorithm. It begins by optimizing the controller variables and testing the system's performance before and after applying the genetic algorithm in the presence of faults, particularly in terms of damping ratio (ζ), maximum overshoot (% MP), settling time (ts), peak time (tp), natural frequency (wn), and damped frequency (wd). As a results, the proposed GA-based PSS2B controller has been implemented to outperform conventional PSS2B in terms of performance indices like maximum overshoot, settling time, and integral squared error (ISE). Overall, the genetic algorithm is a powerful tool for optimizing the transient parameters of a power system stabilizer and improving system stability.

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