Title:	Pelican Optimization Algorithm-Based Proportional–Integral–Derivative Controller for Superior Frequency Regulation in Interconnected Multi-Area Power Generating System
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Abstract:

The primary goal of enhancing automatic generation control (AGC) in interconnected multi-area power systems is to ensure high-quality power generation and reliable distribution during emergencies. These systems still struggle with consistent stability and effective response under dynamic load conditions despite technological advancements. This research introduces a secondary controller designed for load frequency control (LFC) to maintain stability during unexpected load changes by optimally tuning the parameters of a Proportional–Integral–Derivative (PID) controller using pelican optimization algorithm (POA). An interconnected power system for ith multi-area is modeled in this study; meanwhile, for determining the optimal PID gain settings, a four-area interconnected power system is developed consisting of thermal, reheat thermal, hydroelectric, and gas turbine units based on the ith area model. A sensitivity analysis was conducted to validate the proposed controller's robustness under different load conditions (1%, 2%, and 10% step load perturbation) and adjusting nominal parameters (R, Tp, and Tij) within a range of ±25% and ±50%. The performance response indicates that the POA-optimized PID controller achieves superior performance in frequency stabilization and oscillation reduction, with the lowest integral time absolute error (ITAE) value showing improvements of 7.01%, 7.31%, 45.97%, and 50.57% over gray wolf optimization (GWO), Moth Flame Optimization Algorithm (MFOA), Particle Swarm Optimization (PSO), and Harris Hawks Optimization (HHO), respectively.