Qeios

Peer Review

Review of: "TransCapAI: An Optimization Framework for Series Capacitor Allocation to Improve Efficiency and Voltage Stability in Transmission Systems using Machine Learning Techniques"

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The framework was applied to the IEEE 57-bus transmission system, where surrogate models were trained to predict active power losses and the minimum Voltage Stability Index under varying load and compensation conditions.

These models were then embedded within an optimization loop to accelerate the search for high-performing configurations.

The optimized solution produced a 42.50 percent reduction in total active power losses and a 4.56 percent improvement in the minimum Voltage Stability Index, with all results validated through full MATPOWER power flow simulations.

The convergence behavior of the optimization process confirmed the stability and reliability of the machine learning and metaheuristic integration.

This study employed a quantitative, simulation-based research design using the IEEE 57-bus test system as a controlled benchmark environment.

The 57-bus network provides a medium-scale, realistically meshed transmission topology with multiple generators, loads, and power transfer corridors.

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Its structural complexity makes it suitable for evaluating both the effectiveness and computational tractability of the proposed framework.

All analyses were numerical and relied on measurable indicators such as total active power losses and the minimum Voltage Stability Index, which were obtained from repeated MATPOWER power flow simulations under varying load and compensation conditions.

Research paper good

Objectives should be clear

In the base case, the system incurred 27.86375 MW of active power losses and exhibited a minimum VSI of 0.935932 p.u., serving as the reference configuration.

The random baseline, derived from uniformly randomized capacitor allocations across multiple trials, yielded a slightly higher loss of 28.10981 MW (−0.88307% degradation) but improved the VSI to 0.964405 p.u. (a 3.042189% gain).

This outcome illustrates that while random placement may occasionally reinforce local voltage profiles, it lacks consistency and often compromises system-wide efficiency.

Attainment of results should be justified

Its need to specify the attained targets in conclusion

Declarations

Potential competing interests: No potential competing interests to declare.