

RINGKASAN

DESAIN DAN OPTIMASI KONTROL AVR GENERATOR 13.8 KV BERBASIS ANFIS DENGAN PENDEKATAN ALGORITMA METAHEURISTIK GREY WOLF OPTIMIZER (GWO) DAN GENETIC ALGORITHM (GA)

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Generator sinkron 13,8 kV pada PLTP Karaha memerlukan sistem Automatic Voltage Regulator (AVR) yang stabil terhadap variasi beban, sementara pengendali PID masih menunjukkan overshoot dan recovery time yang relatif besar. Penelitian ini menerapkan pengendali Adaptive Neuro-Fuzzy Inference System (ANFIS) yang dioptimasi menggunakan Genetic Algorithm (GA) dan Grey Wolf Optimizer (GWO) pada model AVR berbasis MATLAB/Simulink dengan fungsi fitness Integral of Time Absolute Error (ITAE). Hasil simulasi menunjukkan bahwa ANFIS-GWO memberikan kinerja terbaik. Pada kondisi tanpa gangguan, ANFIS-GWO menghasilkan overshoot terendah sebesar 2,66%, lebih kecil dibandingkan PID sebesar 4,43%. Pada gangguan beban berat $\pm 0,55$ p.u., ANFIS-GWO mencapai recovery time tercepat sebesar 1,289 s dengan undershoot terendah sebesar 2,12%, dibandingkan PID sebesar 1,646 s. Selain itu, pada gangguan $\pm 0,1$ p.u. dan $\pm 0,3$ p.u., ANFIS-GWO mampu mengembalikan sistem ke kondisi steady-state lebih cepat dan stabil. Hasil ini menunjukkan bahwa optimasi ANFIS menggunakan GWO efektif meningkatkan respon dan kestabilan tegangan sistem AVR.

Kata kunci : *Automatic Voltage Regulator, ANFIS, Genetic Algorithm, Grey Wolf Optimizer, ITAE-Modified.*

SUMMARY

DESIGN AND OPTIMIZATION OF 13.8 KV AVR GENERATOR CONTROL BASED ON ANFIS WITH A METAHEURISTIC ALGORITHM APPROACH USING GREY WOLF OPTIMIZER (GWO) AND GENETIC ALGORITHM (GA)

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The 13.8 kV synchronous generator at the Karaha PLTP requires an Automatic Voltage Regulator (AVR) system that is stable against load variations, while the PID controller still shows overshoot and relatively long recovery times. This study applies an Adaptive Neuro-Fuzzy Inference System (ANFIS) controller optimized using Genetic Algorithm (GA) and Grey Wolf Optimizer (GWO) on a MATLAB/Simulink-based AVR model with the Integral of Time Absolute Error (ITAE) fitness function. Simulation results show that ANFIS-GWO provides the best performance. Under no disturbance conditions, ANFIS-GWO produced the lowest overshoot of 2.66%, which is smaller than that of PID at 4.43%. Under heavy load disturbances of ± 0.55 p.u., ANFIS-GWO achieved the fastest recovery time of 1.289 s with the lowest undershoot of 2.12%, compared to PID at 1.646 s. Furthermore, under disturbances of ± 0.1 p.u. and ± 0.3 p.u., ANFIS-GWO is able to return the system to steady-state conditions more quickly and stably. These results indicate that ANFIS optimization using GWO effectively improves the response and stability of the AVR system voltage.

Keywords : Automatic Voltage Regulator, ANFIS, Genetic Algorithm, Grey Wolf Optimizer, ITAE-Modified.