GA and NSGA-Based PID Controllers for Improved Wastewater Treatment Performance: A Comparative Study

Reshma K V
Department of Electronics and Instrumentation Engineering, SRM Institute of Science and Technology, Kattankulathur, Chennai, Tamil Nadu, India
Department of Electronics and Instrumentation Engineering, Vimal Jyothi Engineering College, Chemperi, Kannur District, Kerala, India

Dr. A. Vimala Juliet
Department of Electronics and Instrumentation Engineering, SRM Institute of Science and Technology, Kattankulathur, Chennai, Tamil Nadu, India

Dr. Anusha Chacko
Department of Electronics and Communication Engineering, Vimal Jyothi Engineering College, Chemperi, Kannur District, Kerala, India

Abstract:

Wastewater treatment plants (WWTPs) require particular and dependable control strategies to ensure effluent quality at the same time as minimizing operational fees. conventional proportional–integral–derivative (PID) controllers frequently face demanding situations in coping with the nonlinear and dynamic nature of treatment strategies. To deal with this, optimization-primarily based tuning strategies which consist of Genetic algorithm (GA) and Non-dominated Sorting Genetic algorithm (NSGA-II) have been accomplished to decorate PID controller typical overall performance. This observe offers a comparative evaluation of GA and NSGA-II optimized PID controllers for WWTP programs. The evaluation is finished using manipulate loop responses and normal overall performance indices, particularly Integral of Absolute Error (IAE), Integral of Squared Error (ISE), and Integral of Time-weighted Absolute Error (ITAE). Simulation consequences show that at the identical time as every GA and decorate effluent awareness prediction and system stability compared to standard PID tuning, NSGA-II presents superior alternate-offs in phrases of multi-goal normal average performance. These results demonstrate the potential of multi-goal evolutionary algorithms for more intelligent and environmentally friendly wastewater treatment manipulation.

Keywords:

Genetic Algorithm (GA), IAE, ISE, ITAE, NSGA-II, Multi-objective Optimization, PID, Wastewater Treatment Plants (WWTPs).